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The Great Basin Naturalist

VOLUME XXVIII, 1968

EDITOR: VASCO M. TANNER
ASSOCIATE EDITOR: STEPHEN L. WOOD

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NEW RECORDS AND SPECIES OF NEOTROPICAL BARK BEETLES (SCOLYTIDAE: COLEOPTERA). PART III[1]

Stephen L. Wood[2]

While preparing a taxonomic review of the bark and ambrosia beetles (Scolytidae) of Costa Rica, it was necessary to examine all available species from this and neighboring areas. In order to make the names of new taxa available for this review and for related work, 12 species and two genera (*Paracorthylus* and *Gnathotrypanus*) new to science are described on the following pages. The new species represent the genera *Xyleborus* (3), *Monarthrum* (2), *Paracorthylus* (1), *Gnathotrypanus* (2), *Spermatophthorus* (1), *Scolytus* (2), and *Scolytopsis* (1). The type series of these species were collected in the following countries: Mexico (3), Costa Rica (4), and British Guiana (5).

Xyleborus longideclivis, n. sp.

This species superficially resembles *inconveniens* Schedl, except for the declivity which is more nearly like that of *parallelocollis* Eggers. The general outline of the pronotum and the arrangement of the asperities are much as in *solitarius* Schedl except marginal teeth are absent; the elytral declivity resembles that of *parallelocollis*, but it begins much nearer the base and is less strongly impressed on the lower third.

Female.— Length 2.3 mm. (paratypes 2.2-2.3 mm.), 2.6 times as long as wide; color reddish brown, the declivity darker.

Frons weakly convex; surface reticulate, deeply, rather coarsely punctured; vestiture scanty.

Pronotum 1.04 times as long as wide; widest on basal third; basal angles broadly rounded, middle third of sides weakly arcuate and converging slightly toward the semicircularly rounded anterior margin; summit at or slightly behind summit; asperities rather small, abundant, extending almost to base at lateral margin; posterior area mostly smooth and shining with obscure traces of reticulation

1. Part of the field work relating to this study was sponsored by research grants GB-532 and GB-3678 from the National Science Foundation.

2. Department of Zoology and Entomology, Brigham Young University, Provo, Utah. Scolytoidea Contribution No. 36.

on disc, mostly reticulate laterally, the punctures small, obscure; vestiture inconspicuous.

Elytra 1.6 times as long as wide, 1.5 times as long as pronotum; sides almost straight and parallel on basal two-thirds, rather narrowly rounded behind; disc occupying basal fourth only; striae not impressed, the punctures small, shallow, distinct; interstriae smooth, shining, about three times as wide as striae, the punctures fine, obscure. Declivity occupying the posterior three-fourths, slope very gradual on basal half, somewhat steeper below, broadly convex; striae weakly impressed, the punctures twice as large as on disc, sharply, more deeply impressed; all interspaces weakly convex, about one and one-half times as wide as striae, not entirely smooth or shining, each with a median row of fine, closely set, squamiferous tubercles; lateral margin elevated from posterolateral angles of elytra on interspace 7 to apex of elytra, the elevation acute and irregularly armed by fine granules. Vestiture consisting of uniseriate rows of erect interstrial scales and fine, semirecumbent, strial hair; hair and scales subequal in length, slightly longer near base of declivity; each scale near middle of declivity equal in length to about two-thirds of the distance between rows of scales, separated from scales in the same row by distances equal to their own lengths.

Type Locality.— Bartica triangle, British Guiana.

Host.— *Talisia* sp.

Type Material.—The female holotype and eight female paratypes were collected at the type locality between October 1948 and March 1949, from the above host, as collection number six, by A. D. Atkinson.

The holotype and most of the paratypes are in the British Museum (Natural History); the remaining paratypes are in my collection.

Xyleborus parcellus, n. sp.

This species is allied to *longideclivis*, described above, but it is easily distinguished by the much smaller size and by the shorter declivity. In size and certain other characters it resembles *intersetosus* Blandford, but the declivital sculpture and vestiture are very different.

Female.— Length 1.7 mm. (paratypes 1.6-1.7 mm.), 3.0 times as long as wide; color brown.

Frons as in *longideclivis*.

Pronotum 1.2 times as long as wide; widest on basal third, sides feebly arcuate and very slightly converging on middle third, rather narrowly rounded in front; summit at middle, narrowly elevated; sculpture about as in *longideclivis* except asperities not extending to posterior fourth laterally; vestiture inconspicuous.

Elytra 1.7 times as long as wide, 1.5 times as long as pronotum; outline as in *longideclivus;* disc about one-third length of elytra; striae 1 feebly, others not impressed, the punctures small, distinctly impressed; interstriae smooth and shining, about three times as wide

as striae, the punctures slightly smaller than those of striae. Declivity beginning one-third elytral length from base, very gradual on upper or anterior half, becoming moderately steep below, convex; strial punctures larger and perhaps deeper than on disc; all interstriae uniseriately tuberculate, those on upper half minute, becoming larger and sharply pointed below, less closely placed near apex; lateral margin similarly, but less acutely elevated than in *longideclivus*. Vestiture consisting of minute strial hair and longer, erect, slender interstrial scales; each scale about six times as long as wide, separated from adjacent scales in same and neighboring rows by distances equal to length of a scale.

Type Locality.— Bartica triangle, British Guiana.

Hosts.— *Kairiballi* sp. (type), *Eschweilera sagotianum* and *Eperua falcata* (paratypes).

Type Material.— The female holotype was collected at the type locality between January and March 1949, from the above host, by D. B. Fanshawe. Two paratypes from British Guiana were taken in October 1948, to March 1949, by A. D. Atkinson as follows: one from Ikuribisi, from the second host listed, collection number 63, and one from mile 21 on the Bartica Potaro Road, from the last host listed, collection number 26.

The holotype and one paratype are in the British Museum (Natural History); the other paratype is in my collection.

Xyleborus usticius, n. sp.

The body form and general sculpture of pronotum and elytra superficially are very similar to those of *destruens* Blandford; however, its true affinity appears to be much closer to *parallelocollis* Eggers, although the size and declivital sculpture are rather different. From *parallelocollis* it is distinguished by the larger size, by the stouter body form, by the more broadly rounded posterior outline, by the steeper, broader, more strongly flattened declivity, by the impressed declivital striae, and by the larger declivital tubercles.

Female.— Length 3.2 mm. (paratypes 3.2 mm.), 2.4 times as long as wide; color very dark brown.

Frons transversely convex and longitudinally without arch to well above eyes, the median line slightly higher; a rather narrowly impressed line just above epistoma; surface reticulate above eyes becoming almost smooth below with rather coarse, obscure punctures; vestiture inconspicuous.

Pronotum 1.06 times as long as wide; subquadrate, widest just behind middle, sides moderately arcuate, anterior and posterior margins less strongly arcuate; summit well developed, at middle; anterior area finely asperate; posterior area subreticulate, the punctures minute, rather deep; vestiture confined to lateral margins.

Elytra 1.4 times as long as wide, 1.4 times as long as pronotum; sides straight and diverging slightly on slightly more than basal half, broadly rounded behind; striae 1 moderately, others weakly impressed, the punctures small, close, rather deeply impressed; inter-

striae about twice as wide as striae, subshining, not entirely smooth, the punctures very fine, uniseriate, except irregular in size and position on interspace 1, with margins of some of them appearing very minutely granulate. Declivity beginning at or slightly in front of middle, gradual on anterior half, steeper behind, transversely impressed just before apex; striae more strongly impressed and punctures larger than on disc, the inner floor of some punctures subreticulate; striae 1, 2, and 3 near apex strongly curved toward suture; interstriae equally, weakly convex, each armed by a uniseriate row of closely placed, fine, pointed tubercles. Vestiture evidently abraded, consisting of rows of stout interstrial bristles on side and declivity.

Type Locality.— Bartica District, British Guiana.

Type Material.— The female holotype and one female paratype were collected at the type locality in April, 1957, by E. A. J. Duffy.

The holotype is in the British Museum (Natural History); the paratype is in my collection.

Monarthrum bicolor, n. sp.

Fig. 1

This species superficially resembles several of the larger representatives of the genus, but differs in having the elytral apex entire, not emarginate. The elytral declivity is rather similar to certain species of *Ips*. The sharply defined color pattern is also unusual.

Male.— Length 2.7 mm. (paratypes 2.7-3.0 mm.), 2.5 times as long as wide; color yellowish brown with black markings on asperate area and median third of pronotum to base and on sides and posterior half of elytra; excavated area of declivity also brown except along suture.

Frons broadly convex above eyes, transversely impressed between upper level of eyes and epistomal process; epistomal process broad, weakly elevated and extended orad to almost overlap epistomal margin at center, its lower margin abrupt and bearing a sparse brush of hair; surface smooth, with numerous minute points and coarse, deep punctures above eyes, coarsely reticulate and very obscurely punctured below; a fine median tubercle at upper level of eyes. Antennal club 1.7 times as long as wide, asymmetrical; sutures 1 and 2 evident and septate only on lateral third.

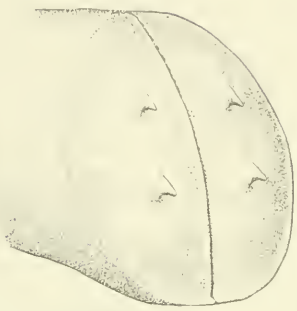
Pronotum 1.1 times as long as wide; sides straight and parallel on basal half, somewhat narrowly rounded in front; anterior area rather coarsely asperate, more finely near summit, with minutely elevated, transverse lines continuing to base behind summit; posterior areas reticulate, very finely, shallowly punctured, the punctures transversely asperate on median third; glabrous.

Elytra 1.4 times as long as wide, 1.3 times as long as pronotum; sides very feebly diverging to one-third from base, then very weakly converging almost to apex, the posterolateral angles strongly rounded, broadly rounded behind; strial and interstrial punctures rather

1. M. bicolor ♂

2. M. preclarus ♂

5. P. velutinus ♂



3a. P. velutinus ♂

4. P. velutinus ♀

3b. P. velutinus ♂

6. P. velutinus ♀

7. G. terebratus ♂

8. G. terebratus ♂

Figs. 1-4. Posterolateral aspect of declivity: 1, *Monarthrum bicolor*, male; 2, *M. preclarus*, male; 3, *Paracorthylus velutinus*, male; 4, *P. velutinus*, female.

Figs. 5-6. Anterior aspect of antenna of *Paracorthylus velutinus*: 5, male; 6, female.

Figs. 7-8. *Gnathotrypanus terebratus*: 7, dorsal aspect of male; 8, anterior aspect of male antenna.

small, deep, confused; surface shining, with rather numerous, minute points. Declivity acutely margined to sutural apex except at sutural interspace above; upper half armed by three pairs of teeth spaced almost equally, the first about in line with interspace 2, acutely pointed, the second about in line with interspace 4, slightly larger but similar to the first, the third, higher but much less acutely pointed, its lower margin continued as a declining crest to sutural apex; excavated area very similar to *Ips*, broadly, deeply, excavated, the sutures slightly elevated and feebly granulate, the surface smooth, shining, the punctures rather large, shallow, not close. Vestiture confined to declivity, consisting of fine hair strongly diverging from suture, the sutural row rather conspicuous.

Female.— Similar to male except frontal area more nearly reticulate; antennal club 1.3 times as long as wide, bearing a tuft of dark setae on posterior face; elytral declivity not excavated, broadly impressed much as in male, the submarginal area armed by three pairs of fine tubercles.

Type Locality.— Mile 10 on the Bartica-Potaro Road, British Guiana.

Host.—*Caryocar nuciferum.*

Type Material.—The male holotype, female allotype, and four male paratypes were collected at the type locality between October 1948 and March 1949, from the above host, by D. J. Atkinson, collection number 67.

The holotype, allotype and two paratypes are in the British Museum (Natural History); the other two paratypes are in my collection.

Monarthrum preclarus, n. sp.

Fig. 2

This species has two pairs of declivital teeth on the elytra having an arrangement different from those of all other representatives of the genus known to me. This feature, at least superficially, is very similar to the declivity of *Tricolus spectabilis* Wood or, to a lesser extent, *T. speciosus* Schedl.

Male.— Length 2.5 mm. (paratype 2.5 mm.), 2.8 times as long as wide; color yellowish brown, the anterior third of pronotum and all except central area on disc of elytra medium brown.

Frons uniformly, rather strongly convex except narrowly impressed at epistomal margin; surface uniformly reticulate-granulate, the punctures very obscure; vestiture confined to epistomal margin.

Pronotum 1.4 times as long as wide; widest at base, sides almost straight and converging slightly on basal two-thirds, then converging rapidly, the anterior margin broadly rounded on median half; declivous on anterior fourth; asperities on anterior third low, abundant, somewhat resembling scales near summit; posterior areas reticulate to subreticulate, the punctures minute, very indistinct; glabrous.

Elytra 1.6 times as long as wide, 1.2 times as long as pronotum; sides straight and parallel on basal third, converging very slightly to

level of sutural apex, then abruptly rounded, very broadly, shallowly emarginate on median half with a narrow, rather deep notch at suture; strial punctures minute, shallow, those of interspaces evidently smaller and less definite in position but rows indicated in some areas; surface smooth, shining. Declivity oblique, excavated; acutely margined beginning with a pair of small, acutely pointed teeth on an elevated base in line with interspace 2 at top of declivity, the subacutely elevated lateral margin continuing to middle of declivity and armed here by a similar pair of small, acutely pointed teeth curving slightly toward middle of declivity; lateral margin continuing from base of second tooth to apex; apex rounded in dorsal profile, its margin continuous with sutural apex; declivital face deeply, broadly excavated, the suture very slightly elevated, the surface smooth, and shining, with fine, shallow punctures. Glabrous, except a few setae on sides.

Type Locality.— Manaka, British Guiana.

Host.— *Peltogyne* sp.

Type Material.— The male holotype and one male paratype were collected at the type locality, from the above host, between October 1948, and March 1949, by D. J. Atkinson, collection number 16.

The holotype is in the British Museum (Natural History), the paratype is in my collection

Paracorthylus, n. g.

This genus bears a superficial resemblance to *Metacorthylus* Blandford, but the antennae and other characters indicate the relationship is remote. It is not closely related to any known genus, but should be placed near *Glochinocerus* Blandford, *Corthycyclon* Schedl, and *Metacorthylus*. The very unique antennae, serve to distinguish this genus.

Description.— Frons convex in both sexes; eye two-thirds divided by a narrow emargination; antennal funicle 2-segmented; antennal club elongate, with two procurved sutures on basal half, sexually dimorphic, strongly, asymmetrically, acuminately produced in female, moderately, not strongly, acuminately produced in male; posterior face of anterior tibiae not tuberculate; tarsi normal. Pronotum much as in *Corthylus*, finely, closely asperate on anterior third. Scutellum large, almost flat. Elytra subtruncate behind. On type-species pubescence minute, recumbent, rather dense on pronotum and elytra.

Type-species.— *Paracorthylus velutinus* Wood, described below.

Paracorthylus velutinus, n. sp.

Figs. 3-6

The sexually dimorphic antennae and armature of the elytral declivity, and the minute, recumbent vestiture serve to distinguish

this species from other species with which it might possibly be confused.

Female.— Length 1.9 mm. (paratypes 1.9-2.0 mm.), 2.2 times as long as wide; color brown, the anterior and posterior extremities somewhat darker.

Frons rather weakly concave; slightly transversely impressed just above epistomal margin; epistomal margin produced into a small lobe in front of mandibles; an acute median carina on lower half extending to apex of epistomal lobe; surface shining, marked by small points and moderately large, close, deep punctures; vestiture erect, minute, inconspicuous. Eye almost two-thirds divided by a narrow emargination. Antennal funicle 2-segmented; club 2.6 times as long as wide, narrowly triangular, the apex acutely pointed; sutures 1 and 2 subangulately procurved, 2 not extending beyond basal third; mediodistal margin bearing a row of rather long hair, other setae minute.

Pronotum 1.1 times as long as wide; widest on basal half, sides on basal two-thirds feebly arcuate, rather broadly rounded in front; summit rather indefinite, about one-third pronotum length from anterior margin; very finely asperate anterior to summit, dull, very minutely reticulate-granulate behind. Vestiture consisting of rather abundant, minute, recumbent hair, somewhat longer and more nearly erect in asperate area.

Elytra 1.1 times as long as wide, 1.0 times as long as pronotum; sides almost straight and parallel to a point beyond level of declivital base, very broadly rounded behind; declivity restricted to posterior fourth; strial and interstrial punctures obsolete, surface of disc finely reticulate, dull, a very slight irregularity where small, confused punctures might have been. Declivity abrupt, very steep, weakly convex; surface obscurely, rather closely punctured, impressed toward suture on upper two-thirds; interspace 3 weakly elevated on upper half, with one blunt tubercle on summit just above middle of declivity. Vestiture minute, recumbent, rather abundant.

Male.— Similar to female except frons more nearly convex, the carina shorter; antennal club shorter, broader, much less strongly acuminate; elytral disc near declivity more nearly shining, more clearly punctured; declivital interspace 3 armed by two moderately large, pointed tubercles, 1 one-third from upper margin, 2 slightly larger, two-thirds from upper margin; lower margin of declivity more distinctly elevated.

Type Locality.— Moravia, Cartago Prov., Costa Rica.

Type Material.— The female holotype, male allotype and 17 paratypes were collected at the type locality on March 11, 1964, at an elevation of about 500 m., by S. L. Wood, from an unidentified, recently cut, dry log. The beetles were monogamous and wood boring. Each tunnel extended about 1-2 cm. directly into the wood. The beetles were completely inactive until physically disturbed.

The holotype, allotype and paratypes are in my collection.

Gnathotrypanus, n. g.

This genus is more closely related to *Gnathotrupes* Schedl than to other known genera, although its relationship to previously described species may appear obscure. It differs from *Gnathotrupes* by the deeply emarginate eye, by the entire elytral apex, and by the presence of only two sutures in the antennal club. In the type-species some of the setae on the elytral declivity are scalelike.

Description.— Frons convex in both sexes; eye about half divided by a broad emargination; antennal funicle 5-segmented; antennal club large, flattened, marked by two procurved sutures (both partly septate in type-species); elytral apex entire; anterior tibiae rather slender, armed by a series of teeth on outer margin and on posterior face by several additional tubercles.

Type-species.— *Gnathotrypanus terebratus* Wood, described below.

Gnathotrypanus terebratus, n. sp.

Figs. 7-8

This species bears a superficial resemblance to certain species of *Thysanoes*, but the eyes, antennae, anterior coxae and legs leave no doubt concerning its relationship to the *Corthylini*.

Male.— Length 1.3 mm. (paratypes 1.30-1.45 mm.), 2.5 times as long as wide; color a moderately dark reddish brown, the pronotum lighter, more nearly yellowish brown.

Frons flattened to well above eyes on an area slightly less than distance between eyes, very feebly elevated toward a broad, low, median, longitudinal elevation; surface very obscurely reticulate with a few very coarse, deep punctures, except shining and impunctate on median elevation; vestiture inconspicuous. Eye half divided by an emargination. Antennal scape about as long as 5-segmented funicle, about half as long as club; club as long as wide, with two procurved, almost angulate sutures, 1 extending one-fourth from base, 2 extending slightly more than half club length from base, most of 1 and extreme margins of 2 septate.

Pronotum 1.1 times as long as wide; widest on basal half, the sides almost parallel, very feebly arcuate to just before middle, then distinctly converging to rather abrupt anterolateral angles, very broadly rounded, almost straight in front; anterior margin armed by about 14-16 low teeth; indefinite summit in front of middle, moderately declivous and finely asperate anterior to summit; posterior area minutely subreticulate, with an occasional minute puncture. A few hairlike setae in asperate area and on lateral areas.

Elytra 1.4 times as long as wide, 1.3 times as long as pronotum; sides almost straight and parallel on basal three-fourths, very broadly rounded behind; striae not impressed, the punctures minute, shallow; interstriae about three times as wide as striae, shining, marked by rather numerous lines, punctures not evident. Declivity steep, confined to posterior fourth of elytra; shallowly, subconcavely impressed on central two-thirds, except sutural area above impressed;

striae obsolete; declivital face closely, minutely marked by indefinite, confused punctures; position of interspace 2 near upper margin armed by a series of two or three small pointed tubercles, the third tubercle almost one-fourth of declivital length from base of declivity; apical, costal margin near suture finely, weakly, elevated. Vestiture confined to declivity, consisting of fine hair and erect scales in about equal numbers; rather sparse.

FEMALE.— Similar to male except frons very slightly more strongly convex; punctures and reticulation of pronotum more distinct; anterolateral margin of pronotum bearing a small tuft of yellow hair; anterior margin of pronotum more strongly rounded; elytral declivity more nearly convex, the impression feeble, the tubercles absent.

TYPE LOCALITY.— Volcan, Puntarenas Prov., Costa Rica.

HOST.— Known locally as "guarumo," evidently *Pourouma aspera.*

TYPE MATERIAL.— The male holotype, female allotype, and 24 paratypes were collected at the type locality on December 11, 1963, at an elevation of about 1,000 m., by S. L. Wood, from a recently cut bole of "guarumo" 20 cm. in diameter, in dense forest growth. The monogamous beetles were just entering the woody tissues of the host.

The holotype, allotype and paratypes are in my collection.

Gnathotrypanus electus, n. sp.

This species is allied to *terebratus*, described above, but may be readily distinguished by the larger size, by the presence of interstrial punctures, and by the sulcate elytral declivity that bears tubercles on the lower half. This species bears a superficial resemblance to certain species of *Neodryocoetes.*

FEMALE.— Length 2.4 mm., 2.4 times as long as wide; color reddish brown with elytra much darker.

Frons moderately convex, with median line rather narrowly elevated, particularly toward epistomal margin; surface dull, very finely, rather closely punctured; vestiture inconspicuous, antennal club with sutures more narrowly angulate than in *terebratus.*

Pronotum 1.1 times as long as wide; sides very feebly arcuate, almost parallel on basal half, rather broadly rounded in front; anterior margin not clearly armed, posterior area minutely reticulate, finely punctured. Subglabrous except at lateral and anterior margins; a moderately large patch of rather long, conspicuous, hairlike setae on anterolateral angle.

Elytra about 1.4 times as long as wide (elytra slightly spread), 1.2 times as long as pronotum; sides almost straight and evidently parallel on about basal three-fourths, very broadly rounded behind; striae not impressed, the punctures small, distinct, shallow; interstriae about three times as wide as striae, the surface shining, marked by lines and exceedingly minute points, and with the punctures

similar in size and spacing to those of striae. Declivity steep, sulcate; striae not indicated, the surface finely reticulate, with very obscure, confused, close punctures indicated; rather strongly impressed between third interspaces, the lateral elevations moderately abrupt, broad, armed by one, small, pointed tubercle near upper margin and four similar tubercles on middle third, the upper one of these four larger. Vestiture confined to declivity, consisting of fine, semirecumbent hair and a few erect, slender scales.

TYPE LOCALITY.— Rincon de Osa, Puntarenas Prov., Costa Rica.

TYPE MATERIAL.—The female holotype was collected at the type locality on August 11, 1967, at an elevation of about 30 m., by S. L. Wood, from the limb of an unidentified tree.

The holotype is in my collection.

Spermatophthorus aberrans, n. sp.

This species is placed in *Spermatophthorus* because of the antennal structure and the scalelike vestiture, but it is not closely related to either of the two previously described species. The very different sculpture of the frons, the reduced size of the head, and the general contour and sculpture of the pronotum and elytra are unique.

MALE.— Length 1.6 mm. (paratypes 1.4-1.7 mm.), 2.4 times as long as wide; color dark brown.

Frons above upper level of eyes convex, with a low median elevation; rather abruptly, strongly, broadly impressed at upper level of eyes, the subconcave area extending from eye to eye to epistomal margin; center of impressed area bearing a pointed tubercle; central part of each ventrolateral fourth of impressed area armed by a large, rounded, strongly developed process about twice as high as its basal width, directed cephalad and very slightly mesad; entire surface dull, above upper level of eyes also clearly reticulate and finely punctured; vestiture inconspicuous.

Pronotum 1.1 times as long as wide; sides almost straight and parallel on basal half, then rather abruptly rounded and continued straight to the very narrow, narrowly rounded anterior margin; anterior margin a continuous, unbroken elevated costa, one pair of low teeth at its ends; dorsal profile a continuous, gradual arch from anterior to posterior margins; isolated, small, crenulate asperities extend to basal margin, surface between asperities irregular, apparently with obscure, coarse reticulation. Vestiture consisting of moderately abundant, erect, slender scales.

Elytra 1.5 times as long as wide, 1.6 times as long as pronotum; sides almost straight and parallel on basal half, then converging gradually to the narrowly rounded posterior margin; striae 1 feebly, others not impressed, the punctures small, shallow, not close or clearly evident; interstriae perhaps three times as wide as striae, very irregular, minutely rather densely punctured, with median row of small, subvulcanate, squamiferous punctures. Declivity convex, rather steep; striae weakly impressed, the punctures more distinct;

interspace 2 strongly narrowed, abruptly, strongly impressed, obsolete before apex; interstrial tubercles slightly larger. Vestiture consisting of interstrial rows of rather slender, erect scales.

Female.— Similar to male except frons weakly, uniformly convex to epistoma, the median elevation continued to epistomal margin with central tubercle minute, the lateral tubercles minute but evident.

Type Locality.— Six km. south of San Vito, Puntarenus Prov., Costa Rica.

Type Material.—The male holotype, female allotype and 30 paratypes were collected at the type locality, between March 19 and 21, 1967, from a pear-shaped gall 3.5 by 4.5 cm. that was picked up on the forest floor by Carlos Valencio.

The holotype, allotype, and paratypes are in my collection.

Scolytus hermosus, n. sp.
Fig. 9

This species is similar to *robustus* Blackman, but is readily distinguished by the larger size, by the more finely punctured pronotum and elytra, by the brightly shining, very finely, densely punctured abdominal sterna, and by the somewhat less strongly elevated anterior margin of abdominal sternum 2.

Male.— Length 3.7 mm. (paratypes 3.0-3.7 mm.), 2.1 times as long as wide; color black with dark reddish brown elytra.

Frons broadly, weakly convex to vertex, with slight transverse impressions just above eyes and just above epistoma; surface shining, rather coarsely punctate-aciculate; vestiture consisting of rather sparse, uniformly distributed, long, dark hair. Antennal club 1.7 times as long as wide; suture 1 distinct.

Pronotum as in *robustus* except punctures distinctly smaller.

Elytra essentially as in *robustus* except strial and interstrial punctures distinctly smaller: interstrial punctures minute, distinctly

9. S. hermosus ♂

10. S. mundus ♂

Figs. 9-10. Posterolateral aspect of abdominal sterna of *Scolytus* spp.: 9, *hermosus;* 10, *mundus*.

smaller than those of striae; posterior margin finely serrate on median third.

Abdominal sternum 2 with anterior margin about two-thirds as high as in *robustus*, the general contour otherwise similar to that species; surface of sterna 2 to 5 brightly shining, very finely, closely, deeply punctured; each puncture bearing a fine, semirecumbent, short hair about two to three times as long as diameter of a puncture.

Female.— Similar to male except frons much more strongly convex; anterior margin of abdominal sternum 2 weakly elevated, the elevation about as high as thick.

Type Locality.— Two km. north of the Puebla state line, 18 km. north of Tlaxco (Tlascala), Puebla, Mexico.

Host.— *Abies religiosa.*

Type Material.— The male holotype, female allotype and 22 paratypes were collected at the type locality on July 9, 1967, at an elevation of 2,900 m., by S. L. Wood, from fir slash larger than 10 cm. in diameter. The egg tunnels were transverse. These beetles were associated in the same slash with the following species.

The holotype, allotype and paratypes are in my collection.

Scolytus mundus, n. sp.
Fig. 10

This species is allied to *ventralis* Leconte, but is readily distinguished by the larger size, by the more finely punctured elytra, by the shining, much more coarsely punctured abdominal sterna, and by the larger spine (male) or tubercle (female) on the posterior margin of sternum 2.

Male.— Length 4.5 mm. (paratypes 3.6-4.5 mm.), 2.3 times as long as wide; color black.

Frons moderately convex with a shallow, rather broad, median impression just above epistoma; surface longitudinally, rather coarsely punctate-aciculate, with a slight median longitudinal carina on middle third; vestiture of moderately abundant, uniformly distributed, fine, long hair; antennal club 2.0 times as long as wide; suture 1 obscurely indicated.

Pronotum essentially as in *ventralis*.

Elytra about as in *ventralis* except punctures smaller, deep; strial and interstrial punctures about equal in size; posterior margin almost smooth, with a distinct shallow notch in line with interspace 3.

Abdominal sternum 2 abruptly declivous (about a 90 degree angle) but margin not projecting posteriorly; posterior median margin of 2 armed by a rather large, sharply pointed spine, its apex at suture, its anterior slope descending gradually to about middle of segment much as in *obelus* Wood; all sterna shining, rather finely, closely, deeply punctured; each puncture bearing a fine, long hair, each hair about equal in length to length of sternum 3.

Female.— Similar to male except frons much more strongly convex, the impression obsolete, but with a small median impression

on vertex, surface much less strongly aciculate; abdominal sternum 2 more nearly convex, not as steeply declivous, the spine rudimentary (not entirely obsolete in any female at hand); abdominal vestiture abraded.

Type Locality.— Two km. north of Puebla state line, 18 km. north of Tlaxco (Tlascala), Puebla, Mexico.

Host.— *Abies religiosa.*

Type Material.— The male holotype, female allotype and 32 paratypes were collected at the type locality on July 9, 1967, at an elevation of 2,900 m., by S. L. Wood, from fir slash larger than 10 cm. in diameter. The egg tunnels were transverse and could not be distinguished from those of *hermosus*, above, with which they were associated.

Scolytopsis laticollis, n. sp.

This species is allied to *puncticollis* Blandford, but it is readily distinguished by the much smaller lateral punctures on the pronotum, by the narrowly, deeply impressed declivital interstriae, and, in the female, by the more nearly flattened, much more pubescent frons, with a more prominent median carina.

Female.— Length 2.8 mm. (paratypes 2.5-3.1 mm.), 2.2 times as long as wide; color dark brown.

Frons broadly convex on upper two-thirds, transversely impressed below, epistomal margin rather abruptly elevated, shining; a narrow, rather strongly elevated median carina extending from upper level of eyes to epistomal elevation; surface coarsely, closely, deeply punctured; vestiture consisting of fine, rather long, moderately abundant, hairlike setae on a subtriangular area from epistoma to upper end of carina.

Pronotum 0.90 times as long as wide; widest just behind middle, sides rather strongly arcuate, converging somewhat on anterior half to the rather broadly rounded anterior margin; surface smooth and shining, with moderately abundant minute points and rather widely spaced, oval punctures of moderately large size, the punctures spaced on disc by about one to two times their own diameter except on median line, in lateral areas the punctures distinctly less than twice as large as on disc, the surface very obscurely reticulate. Glabrous.

Elytra 1.4 times as long as wide, 1.4 times as long as pronotum, slightly narrower than pronotum; sides moderately constricted one-fourth from base, then arcuate and converging on posterior half to broadly rounded posterior margin; striae narrowly, rather deeply impressed from just behind base to just before apex, the punctures rather small, distinct; interstriae at least twice as wide as striae, with punctures as large, deep and close as those of striae, the middle third of each interspace not impressed on basal fourth of elytra, gradually impressed with increasing depth posteriorly until equal to striae on posterior fourth; general surface shining, with moderately numerous minute points; apical margin elevated, subserrate. Vesti-

ture consisting of stout, short, interstrial setae, becoming almost hairlike on posterior fourth.

Male.— Similar to female except frons modified as in males of related species but with longer setae; setae of elytral declivity more nearly scalelike.

Type Locality.— Thirty-one km. southeast of Cameron, Oaxaca, Mexico.

Type Material.— The female holotype, male allotype and 13 paratypes were collected at the type locality on June 21, 1967, at an elevation near 1,300 m., by S. L. Wood, from cut limbs about 8 to 15 cm. in diameter. The biramous transverse egg tunnels engraved the wood; the larval mines were mostly in the phloem. The general appearance of the tunnels was very similar to that of many species of *Scolytus*. The specimens taken were dead remnants of a recent epidemic that infected several host trees, one of which appeared to be *Plumeria* sp.

The holotype, allotype and paratypes are in my collection.

Ips sabinianae (Hopping), n. comb.

Through an oversight *Orthotomicus sabinianae* Hopping (1963, Canadian Ent. 95:64), from California, was not formally transferred to the genus *Ips* when treating *Ips latidens* LeConte (Wood, 1966, Gt. Basin Nat. 26:24). These two species and *erosus* (Wollaston), from Europe, form a group intermediate between *Ips* (*s. str.*) and *Orthotomicus*. For several practical reasons, including the probable invalid status of *Orthotomicus*, this species group should be included in *Ips*.

UNDESCRIBED SPECIES OF NEARCTIC TIPULIDAE (DIPTERA) VIII

Charles P. Alexander[1]

The species discussed herewith are from Alaska and the Canadian Northwest, having been collected by the late Owen Bryant, William C. Frohne, and by members of the Alexander-Smith collecting expedition to Alaska in 1952, including Mr. David L. Carson, Dr. Marion E. Smith, and the writer. A brief account of this trip may be found in an earlier paper (Alexander, C. P. The crane-flies of Alaska. Univ. Michigan, Mus. Zool., Misc. Publ. 90: 7; 1955). I express my sincere thanks to all of the above for the privilege of retaining the types of the species concerned.

Tipula (*Arctotipula*) *smithae*, n.sp.

Allied to *miyadii;* general coloration of thorax blackened, heavily light gray pruinose, praescutum with four darker gray stripes; antennae relatively long, black throughout; femora brownish yellow, tips abruptly black, claws of male toothed; wings light brown, stigma freckled by light brown dots; male hypopygium with tergal lobes doubled by having a secondary lobule beneath each; outer dististyle broad, inner style with beak very slender, outer margin of style near base with a small lobule.

Male.— Length about 15.5 mm.; wing 14.5 mm.; antenna about 4.3 mm.

Frontal prolongation of head brown, heavily light gray pruinose; nasus elongate, with long brownish yellow setae; palpi dark brown. Antennae black; scape elongate, nearly equal to the following three segments combined; basal enlargements of flagellar segments moderately developed, verticils shorter than segments. Head light gray, clearer on front and orbits, posterior vertex with vague indications of a brownish central line.

Pronotal scutum dark gray, scutellum horn yellow. Mesonotal praescutum blackened, heavily light gray pruinose, disk with four darker gray stripes, the intermediate pair narrow, united at anterior ends; posterior sclerites of notum blackened, heavily pruinose, parascutella conspicuously horn yellow; vestiture of notum whitened, relatively short and inconspicuous. Pleura darkened, heavily gray pruinose, dorsopleural membrane brownish yellow. Halteres with stem brownish yellow, knob light brown, apex pale. Legs with coxae light gray, with long pale setae; trochanters dark gray; femora brownish yellow, tips abruptly black; tibiae brownish yellow, inconspicuously darkened at outer end; tarsi black, proximal end of basitarsi paler; claws of male setuliferous, with a stout erect spine at

[1]Amherst, Massachusetts

near midlength. Wings tinged with light brown, costal field only slightly darker; stigma darker, the pattern comprised of microscopic brown dots; veins brown. Veins posterior to *R* glabrous, as common in the subgenus. Venation: *Rs* about two and one-half times R_{2+3}; petiole of cell M_1 a little less than *m;* M_{3+4} short, from about one-third to two-thirds the basal section of M_{1+2}.

Abdomen with basal segment dark brownish gray, succeeding tergites orange yellow with a narrow dark brown central line that is interrupted at the posterior borders of the segments, lateral margins broadly yellowed; basal sternites dull orange, vaguely darkened medially; fifth and succeeding segments blackened, pruinose. Male hypopygium with lobes of tergite broadly obtuse to subtruncate at tips, separated by a narrow U-shaped emargination; lobes with a smaller darkened secondary lobule beneath each; surface of tergal plate with very abundant short black setae almost to base. Outer dististyle relatively broad, widest across the basal half, setae relatively long, pale yellow, inconspicuous; inner style with beak very slender, narrowed gradually outwardly, tip subacute, spine at base blackened, gently curved; outer margin of style at base in region of the outer basal lobe setiferous and bearing a small lobule. Phallosome with aedeagus slender, the apophyses nearly as long, narrow, the outer half membranous. Eighth sternite with posterior border very gently convex, unmodified; setae small, not crowded.

Habitat.— Alaska.

Holotype, ♂, Sable Pass, McKinley National Park, along the park highway, July 20, 1952 (Marion E. Smith).

The species is dedicated to the collector, Dr. Marion Estelle Smith, of the Entomological Department of the University of Massachusetts. The most similar species is *Tipula* (*Arctotipula*) *miyadii* Alexander, described from Paramushir Island, in the northern Kurils (Kuriles), Soviet Union. The latter differs in the shorter antennae, simple tarsal claws of male, uniformly darkened stigma, and especially in the details of the hypopygium, including the tergite and both dististyles. The beak of the inner style in the present fly is the most slender of any species of the subgenus so far made known.

Tipula (*Yamatotipula*) *toklatensis*, n.sp.

Size medium (wing of male to 13 mm.); general coloration of head and thorax opaque gray, praescutum with four darker brown stripes, notal vestiture short; wings faintly tinged with brown, stigma dark brown. *Rs* long, about twice R_{2+3}, cell M_1 deep, M_{3+4} very short; abdomen with proximal tergites reddish, patterned with brown, sternites and outer segments dark brown; male hypopygium with posterior border of tergite produced into two parallel lobes provided with spinoid setae; outer dististyle elongate, expanded outwardly; phallosome simple, gonapophyses not developed; eighth sternite with central area of posterior border pale yellow, membranous, on either side with very long pale setae.

Male.— Length about 12-13 mm.; wing 12-13 mm.; antenna about 5 mm.

Female.— Length about 14-15 mm.; wing 9-11 mm.; antenna about 2.5 mm.

Frontal prolongation of head dark brown above, broadly yellowed on sides, in cases the ventral surface weakly infuscated; nasus black, with long yellow setae; palpi dark brown. Antennae brownish black; flagellar segments of male with basal enlargements slightly developed, verticils shorter than the segments. Head light gray, occipital region restrictedly patterned with yellow.

Pronotal scutum gray, scutellum yellowed. Mesonotal praescutum light gray, with four darker brown stripes, the broad central area somewhat paler, with a further vague darkened median line, interspaces with numerous very short yellow setae; scutum light gray, lobes vaguely darkened; posterior sclerites gray, parascutella light brown; pleurotergite gray, katapleurotergite with an elongate more yellowed area; vestiture of notum unusually short and inconspicuous. Pleura light gray, dorsopleural region buffy yellow; vestiture of ventral pleurites short and inconspicuous. Halteres with stem light brown, knob dark brown. Legs with coxae gray, with long pale setae; trochanters brownish yellow; femora and tibiae light brown, tips brownish black; tarsi black, claws of male with a strong tooth. Wings faintly tinged with brown, stigma oval, dark brown; veins brown. Wings of female proportionately a little smaller than those of male. Veins beyond cord with numerous trichia, including also the outer ends of *M*, *Cu* and *2nd A*. Venation: *Sc* long, Sc_2 ending shortly beyond midlength of *Rs*, the latter long, about twice R_{2+3}; cell M_1 very deep, the petiole short, commonly about one-fourth to one-fifth *m*, in cases the two veins subequal; M_{3+4} very short, in cases punctiform, *m-cu* at base of M_4.

Abdomen with basal segment gray, yellowed basally, tergites two to five reddish, darkened medially and less evidently as narrow sublateral lines, the lateral borders yellowed, sternites and outer segments dark brown, styli of male hypopygium light brown; abdominal vestiture relatively short, yellow, long and conspicuous on eighth sternite of male, as described. Ovipositor with cerci long and slender, straight, narrowed very gradually to the subacute tips, hypovalvae much shorter. Male hypopygium generally as in *Yamatotipula*, especially the tergite and inner dististyle, the other features, especially the outer dististyle and phallosome, different. Suture between tergite and the large basistyle indicated distally, ventral suture conspicuous, blackened, its cephalic end curved dorsally. Ninth tergite transverse, median area of posterior border produced into two lobes that are provided apically with numerous spinoid setae, the emargination narrow; outer lateral angles of tergite broadly rounded, provided with numerous small setae. Outer dististyle elongate, strongly expanded outwardly, widest across apex; inner style with beak slender, dorsal crest low; region of outer basal lobe large and complex, including a narrowed blackened lobe that occupies the position

normal for the lower beak, and a broader flattened plate with three acute points along its margin, the most basal one larger. Phallosome a simple rod, terminating in a small decurved subapical point, apophyses apparently not developed. Eighth sternite extensive, posterior border with a broad central light yellow membranous area, the margin thus appearing generally concave; on either side of midline the tergite with a concentration of very long pale setae.

HABITAT.— Alaska.

HOLOTYPE, ♂, Toklat River, McKinley National Park, along the park highway, July 20, 1952 (David L. Carson). ALLOTOPOTYPE, ♀, pinned with a paratype male. PARATOPOTYPES, 14 ♂♂, 1 ♀, with the types, on six pins.

I am assigning this interesting species to the subgenus *Yamatotipula* Matsumura with some question. While agreeing in some features of the hypopygium, including the tergite and inner dististyle, the fly differs in other respects, as the outer dististyle, phallosome, and eighth sternite. In its general appearance it suggests species such as *Tipula* (*Yamatotipula*) *dejecta* Walker, *T.* (*Y.*) *grenfelli* Alexander, and others. Certain features of venation and hypopygial structure likewise suggest the genus *Nephrotoma* Meigen but the species unquestionably is referrable to the assigned genus.

Erioptera (*Psiloconopa*) *chaetophora*, n.sp.

Size small (wing of male about 4 mm.); general coloration of head and thorax light gray; head and thorax, including the pleura, with conspicuous stout black setae; tips of femora and tibiae slightly dilated; wings pale brown, veins unusually glabrous, cell M_2 open by atrophy of basal section of M_3; male hypopygium with outer dististyle blackened, terminating in three unequal points or blades; arms of aedeagus long and sinuous, narrowed gradually into slender points.

MALE.— Length about 4.5 mm.; wing 4.1 mm.

Rostrum brown, palpi black. Antennae with scape obscure yellow, pedicel brownish black, flagellum black; flagellar segments oval, the terminal pair partially fused; verticils shorter than the segments, the outer ones longer. Head light gray, vertex and genae with stout black setae, the more lateral ones longer, all slightly porrect.

Thoracic dorsum light gray, pseudosutural foveae black; scutellum dark brown medially, more reddened behind, parascutella obscure yellow; pronotum, praescutal interspaces and mesal parts of scutal lobes with conspicuous stout erect black setae. Pleura variegated light yellow and gray, the latter pattern including the ventral anepisternum, sternopleurite, meron and metapleura; sparse scattered erect black setae on all pleural sclerites with the exception of the meron. Halteres light yellow. Legs with coxae grayish brown, with sparse black setae; trochanters obscure yellow; femora brownish yellow, tips of fore and middle pairs narrowly dilated, brownish black, the posterior pair scarcely enlarged or darkened; tibiae of all legs obscure yellow, bases and the slightly dilated apices dark brown

to brownish black; proximal tarsal segments yellow, outer three brownish black to black; vestiture of legs small and weak, longer at tips of all segments. Wings pale brown, prearcular and costal fields light yellow, stigma scarcely more darkened; veins pale brown, more yellowed in the brightened fields. Wing veins unusually glabrous, the costal series short; sparse scattered trichia on veins R_1 and R_{1+2}, with about fifteen on distal section of R_5, concentrated on outer third. Venation: Sc_1 ending about four-fifths Rs, Sc_2 retracted; R_{2+3+4} slightly longer than R_{2+3} or basal section of R_5; cell M_2 open by atrophy of basal section of M_3; cell *2nd* M_2 longer than its petiole, *m* lacking, vein M_3 being in nearly longitudinal alignment with M_{1+2}; *m-cu* shortly before fork of M; Anal veins divergent, *2nd A* curved gently to margin.

Abdominal tergites brownish gray, lateral borders light yellow; sternites and hypopygium brownish yellow. Male hypopygium with tergite relatively small and narrow, posterior border nearly truncate. Basistyle slender, dististyles terminal; outer style blackened distally, bifid at apex, the smooth blade unequally bispinous, the second blade with microscopic denticles at apex and along outer margin; inner style very broad, smooth, apex obtuse. Gonapophyses appearing as simple blackened hooks, the outer third somewhat angularly bent into a long spine. Arms of aedeagus appearing as longer pale blades that narrow very gradually into very slender divergent spines.

Habitat.— Canadian Northwest Territories.

Holotype, ♂, Good Hope, District of Mackenzie, along Mackenzie River, August 22, 1929 (Owen Bryant); No. 73. Note attached by Bryant "Has this thing got rheumatism?", referring to the enlarged apices of the femora and tibia.

The present fly is quite distinct from all other regional members of the subgenus in the chaetotaxy of the head and thorax, the venation, particularly of the medial field, the nearly glabrous wing veins, and the hypopygial structure. In its venation it is most similar to *Erioptera* (*Psiloconopa*) *mckinleyana* Alexander, of Alaska, which is readily told by the lack of modified body setae, normal legs, trichiation of the wing veins, and the structure of the male hypopygium.

Erioptera (*Symplecta*) *platymera*, n.sp.

General coloration of thorax brownish gray, patterned with darker brown and light yellow; wings faintly tinted, with diffuse brown markings; male hypopygium with dististyles terminal, outer style ending in either three or four blackened points, inner style a flattened blade that is gently widened outwardly, apex very obtuse to subtruncate; gonapophyses appearing as broad flattened dark-colored blades, the inner apical angle produced into a strong black spine, apophysis without an accessory blade or lobe.

Male.— Length about 6 mm.; wing 5.8 mm.

Head broken. Pronotum light gray, darker laterally, pretergites and propleura yellowed. Mesonotal praescutum brownish gray, the

interspaces narrowly and vaguely darker brown, humeral region yellowed, pseudosutural foveae black; posterior sclerites of notum brownish gray, posterior borders of scutal lobes, lateral margins of mediotergite and cephalic area of pleurotergite yellowed; praescutum and scutum with conspicuous erect white setae. Pleura with mesepisternum, meron and metapleura brownish gray, pteropleurite obscure yellow. Halters with stem pale yellow, under end of knob weakly darkened. Legs with coxae brownish gray; trochanters obscure yellow; remainder of legs dark brown. Wings faintly tinted, with vague more whitened areas; a diffuse brown pattern includes clouds at origin of *Rs*, cord, top of R_{1+2}, supernumerary crossvein in cell R_3 and outer end of cell *1st* M_2; veins dark brown. Venation: Sc_2 opposite origin of *Rs*; supernumerary crossvein at near midlength of cell R_3; *m-cu* about one-half its length before fork of *M*; terminal loop of vein *2nd A* small.

Abdomen dark brown. Male hypopygium with dististyles terminal; outer style with stem stout, at apex divided into two more blackened arms that subdivide into one or two points that terminate in three or four obtuse knobs; inner style a flattened blade that widens gently outwardly, apex very obtuse to subtruncate. Gonapophyses appearing as broad flattened dark-colored blades, the inner apical angle produced into a strong black spine, the remaining outer margin with microscopic points; no accessory blade or lobe as in *cana* or *hybrida*. Terminal filaments of aedeagus slender.

HABITAT.— Canada (Yukon).

HOLOTYPE, ♂, Alaska Highway, Mile 1152, along Lake Creek, July 7, 1952 (C. P. Alexander).

Erioptera (*Symplecta*) *platymera* is told readily from the four other regional members of the subgenus by the structure of the male hypopygium, particularly the broad gonapophyses, which has suggested the specific name. The hypopygia of the other species were figured by the writer in an earlier paper (Univ. Michigan, Mus. Zool., Misc. Publ. 90:28-30, figs. 33-36; 1955). The species concerned are *E.* (*S.*) *cana* (Walker), *E.* (*S.*) *hybrida* (Meigen), *E.* (*S.*) *sheldoni* Alexander and *E.* (*S.*) *sunwapta* Alexander.

Ormosia (*Parormosia*) *frohnearum*, n.sp.

Allied to *divergens;* general coloration of the body dark brown; antennae relatively long, exceeding one-fourth the length of wing; wings weakly tinged with brown, M_{3+4} long, subequal to M_4; male hypopygium with apex of lobe of tergite truncate; outer dististyle bifid, outer arm a slender rod, inner arm stout, curved, at apex with a single powerful spine and numerous smaller points; inner style with apex expanded into a triangular blade, the outer margin with about eight long setae.

MALE.— Length about 5 mm.; wing 5.2 mm.; antenna about 1.6 mm.

Rostrum and palpi dark brown. Antennae relatively long, dark brown throughout; flagellar segments long-oval, with abundant delicate white setulae, verticils very small. Head brown.

Thorax almost uniformly dark brown; pretergites obscure yellow. Halteres brownish yellow, the large knobs clearer yellow. Legs with coxae yellowish brown; trochanters yellow; remainder of legs brown. Wings with a weak brownish tinge, prearcular field slightly more yellowed, stigmal area scarcely darker than the ground; veins light brown. Venation: Sc_1 ending shortly beyond the slightly oblique R_2; cell M_2 open by atrophy of m; M_{3+4} long, subequal to M_4 in *divergens* much shorter, approximately one-fourth M_4; *m-cu* close to fork of M; Anal veins divergent.

Abdomen, including hypopygium, dark brown. Male hypopygium quite different from that of *divergens*, especially the tergite and dististyles. Ninth tergite with apex of outer lobe truncate; surface with abundant relatively small setae. Outer dististyle conspicuously bifid, the outer arm a slender rod, on inner face near base with a spine or spur; inner arm much stouter, strongly curved, apex with a single powerful spine and several smaller ones; inner style with stem slender, apex extended laterad into a triangular blade, the outer margin with about eight long setae.

Habitat.— Alaska (First Judicial District).

Holotype, ♂, Auke Bay, Juneau, July 10, 1952 (William C. Frohne).

The species is named for the Frohne family, William C. and Gertrude Frohne, with their son Richard who was 13 years of age in 1952 when the species was taken. I am greatly indebted to the Frohnes for several new and rare crane flies that were taken in the Juneau area, chiefly in 1952. At that time, Dr. Frohne was Senior Scientist (Entomology), in the Department of Health, Education and Welfare, Alaska. Presently he is with the Alaska Methodist University, Anchorage, Alaska.

The nearest relative of the present fly is *Ormosia* (*Parormosia*) *divergens* (Coquillett), with a wide distribution in western North America. This differs particularly in the venation and in the hypopygial structure, especially the tergite and dististyles.

Molophilus (*Molophilus*) *frohnei*, n.sp.

Size large (wing of male 6 mm.); mesonotum grayish brown, praescutum light yellow laterally; rostrum, palpi and proximal antennal segments black; halteres yellow; wings light yellow, trichia light brown; male hypopygium with mesal and ventral lobes of basistyle distal in position, placed beyond the point of insertion of the dististyles; inner dististyle nearly straight throughout, outer half narrowed into a strong spine, its margin with numerous microscopic spinules.

Male.— Length about 5.5 mm.; wing 6 mm.

Rostrum and palpi intensely black, the former with long black setae. Antennae with scape and pedicel black; flagellum broken, head gray.

Pronotal scutum yellow, scutellum clearer yellow, dark brown laterally. Mesonotal praescutum with disk grayish brown, without distinct stripes; pretergites and humeral region light yellow, lateral tergal borders more obscure yellow; scutum brownish gray, posterior borders of lobes yellow; scutellum brownish gray, vaguely more yellowed at apex, parascutella obscure yellow; mediotergite brown, the interpostnotal suture broadly yellow. Pleura and pleurotergite light brown. Halteres yellow. Legs with coxae and trochanters yellow; remainder of legs broken. Wings light yellow, the veins more saturated pale yellow; trichia light brown.

Abdomen dark brown, hypopygium more yellowish brown. Male hypopygium with apex of dorsal lobe of basistyle narrowly obtuse; ventral and mesal lobes far distad, beyond the level of point of insertion of the dististyles, the mesal lobe with relatively sparse blackened spinoid setae. Outer dististyle strongly bent beyond midlength, the lower surface of outer part with about 8 or 9 blackened points; inner style distinctive, about two-thirds as long as outer style, nearly straight throughout; basal half yellow, slightly dilated near outer part, thence narrowed to a more slender straight blackened spine, its margin with numerous microscopic spinules.

HABITAT.— Alaska (First Judicial District).

HOLOTYPE, ♂, Eagle River, near Juneau, June 14, 1952 (William C. Frohne).

I am pleased to name this fly for Dr. William C. Frohne. It is generally similar to species such as *Molophilus* (*Molophilus*) *distilobatus* Alexander, *M.* (*M.*) *spiculatus* Alexander, and some others, differing in hypopygial structure, particularly the inner dististyle.

DISTRIBUTIONAL ASPECTS OF *PINUS PONDEROSA* IN NORTHWESTERN NEBRASKA[1]

John L. Main[2] and Elray S. Nixon[3]

Abstract

Pinus ponderosa occurs in abundance on the Pine Ridge escarpment in northwestern Nebraska. Within and adjacent to the Pine Ridge are areas of mixed-grass prairie. Transects were run in the middle and along fringe areas of pine stands to determine if *P. ponderosa* was encroaching upon the grasslands of the surrounding mixed prairie areas. Results indicated that encroachment was taking place, especially in areas of soil disturbance or where a more open type of vegetation existed.

Introduction

Pinus ponderosa is one of the most widely distributed pine species in the forested mountainous areas of western North America. Although it is usually found at lower altitudes on dry elevated slopes, it possesses a wide ecological tolerance range. At the present time the largest acreage of *P. ponderosa* in Nebraska occurs on the Pine Ridge escarpment in northwestern Nebraska, but it is also abundant on the Wild Cat Range and along the Platte and Niobrara Rivers in the Mixed Prairie region (Tolstead, 1947). Bessey (1895) indicated that the distribution of *P. ponderosa* may have been much greater prior to the early settlement of the white men. He suggested that the sandhills of Nebraska were probably once wooded by *P. ponderosa* as evidenced by remains of wood fragments and testimonies of the first settlers of the sandhills region. Because of the abundance of timber, sawmills came into the area and by the early 1900's there were sixty-five in the Pine Ridge area alone. Because of this clearing effect, the average age of the oldest trees is approximately 65-70 years, a uniformity resulting from reproduction occurring within a few years after the extensive cutting (Tolstead, 1947).

This study deals specifically with a population of *P. ponderosa* on the Pine Ridge escarpment near Chadron, Nebraska. The topography is one of sharp ridges, eroded sandstone buttes, and rough broken areas. The vegetation is characterized by stands of *P. ponderosa* interspersed with areas of mixed prairie (Fig. 1). The dominant species of the woodland areas are *P. ponderosa* and *Prunus virginiana* whereas the mixed prairie areas are generally dominated by the grasses *Andropogon scoparius*, *Poa pratensis*, *Stipa comata*, and *Bouteloua curtipendula* and other species such as *Carex filifolia* and *Yucca glauca* (Tolstead, 1947; Nixon, 1967).

The purpose of this study was to determine if *Pinus ponderosa* was encroaching upon the grasslands of the surrounding mixed

1. Appreciation is extended to Doris Gates, Chadron State College, Chadron, Nebraska, and to Peter N. Jensen, Soil Conservation Service, Lincoln, Nebraska, for helpful suggestions.
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Fig. 1. *Pinus ponderosa* and adjacent prairie areas characteristic of the Pine Ridge escarpment in northwestern Nebraska (Soil Conservation Service photo, 1960).

prairie areas and to determine those factors which may be enhancing or inhibiting the advancement of the pine. This in turn may aid in a better understanding of the distribution of pine on the Pine Ridge escarpment. The study commenced in the spring of 1965 and terminated in the fall of that same year.

Description of Study Sites

Ten sample sites were located in Dawes County, Nebraska, all within six miles of each other and, therefore, were similar in temperature and precipitation. The annual precipitation is approximately 17.97 inches, most of which occurs between the months of April and September; however, the amount of precipitation fluctuates within wide limits from year to year. The average temperature for January is 24.4° F and for July is 75.6° F (U. S. Dept. of Agriculture, 1941). The average growing season is 146 days. The study sites varied somewhat in slope exposure, size, topography, and in vegetation marginating the pine stands.

Sites A, B, and C were located in rather close proximity approximately five miles south of Chadron, Nebraska, on U. S. Highway 385 and then six miles southeast on Kings Canyon road. The prairie vegetation at the margin of these sites was primarily composed of *Bouteloua gracilis*, *B. hirsuta*, *B. curtipendula*, *Agropyron smithii*, and *Stipa comata*. The general slope exposure of site A was to the northeast, site B to the west, and site C to the north.

Sites D, E, and F were located approximately five miles south of Chadron on U. S. Highway 385 and three and one-half miles southeast on Kings Canyon road. Marginal prairie areas at sites E and F were characterized by the presence of an abundance of *Andropogon scoparius* and *A. gerardi* and the general slope exposure was to the east. Site D was different from E and F in that the northeast-facing slopes terminated in a bottom area with a dense growth of vegetation including such species as *Poa pratensis*, *Symphoricarpos occidentalis*, and *Rhus radicans*. The top of the ridge was flat with well spaced pines and a ground cover of the grasses *Stipa comata* and *Bouteloua curtipendula*. The uppermost part of the ridge at site F was a sandstone butte.

The remaining sites (G, H, I, and J) were in and near Chadron State Park which is located nine miles south of Chadron on U. S. Highway 385. The uppermost portion of the ridges at sites G and H were sandstone buttes. The general slope exposure was to the east and the more prominent prairie species were *Andropogon scoparius* and *A. gerardi*. Sites I and J sloped west and northwest, respectively, terminating in bottom areas. Representatives from the prairie included *Stipa comata* and *Calamovilfa longifolia*. There were also shrubs present such as *Prunus virginiana* and *Symphoricarpos occidentalis* and in some places patches of the grasses *Poa pratensis* and *Panicum virgatum*.

Methods and Procedures

Ridge areas were selected which projected into mixed prairie areas. Belt transects were run down the middle of the ridge and along the fringe areas of the pine stands. The transects varied in length from site to site but were all five meters wide. Ridge transects followed the contour of the ridge while fringe transects followed the contour of the pine stands, beginning with the outermost tree and including all trees inward for five meters.

The 947 increment borings were from pines over four cm in diameter. All trees with diameters four cm or less at a height of one meter are specified as seedlings. Other aspects noted were natural pruning and top structure. Three soil samples were taken at each site. Samples of the top eight inches were taken from under well established pines, from transition areas between pine and prairie, and from the adjacent prairie. Soil samples were collected in quart plastic bags, screened and air dried, and again stored in plastic bags. Duplicate samples were used for pH determinations. The pH of the soil was determined from a water-saturation percentage preparation (Jackson, 1958) and measured on a Beckman Model 76 pH meter buffered at pH 6:86.

Results

Examination of the transition zones between pine stands and grasslands failed to produce any signs of retreating pine margins. To

the contrary, many areas showed young seedlings established among grasses and other vegetation. The number of seedlings, however, was higher in the ridge transects than the fringe transects. It was noted that migration took place at a much faster rate in areas of soil disturbance and when in association with open stands of bunchgrasses such as *Andropogon scoparius*. Slope exposure also seemed to play an important role in encroachment. It was noted that migration took place on east- and north-facing slopes at a much faster rate than on west- and south-facing slopes.

The mean diameter of all trees sampled was 16.73 cm. Because of the great variance in environmental factors, it was impossible to determine age by measuring the diameters of the trees. As a result, cores were used to determine the age of all trees encountered. The mean age of all trees sampled was 44.4 years, while the mean age for trees in the fringe transects was 31.3 years, and the mean age for trees in the ridge transects was 56.2 (Table 1). A difference of 24.9 years in average age between trees in the ridge and fringe transects indicates that migration has taken place. Further evidence of migration is found in the age class results (Table 2). Of the 526 trees in the fringe areas, 78 percent were less than 36 years of age. In the ridge areas 55 percent of the 859 trees were less than 36 years of age. There were only 32 trees over 45 years of age in the fringe transects whereas in the ridge transects there were 256 trees over 45 years of age. The age range for all trees sampled was from 12 to 274 years, and the diameter range from 4 to 57 cm at one meter in height. The average distance between ridge and fringe transects was 61.6 meters.

The average height of trees sampled was 7.9 meters while the average height of trees in the fringe transects was 7.5 meters and the average height of trees in the ridge transects was 8.3 meters (Table 1). Most trees in the sample sites had not dropped their lower branches and only 23 out of the 948 trees sampled had flat tops, indicating that most of the trees sampled were still growing.

The soil pH of the top 8 inches ranged from 6 to 7.9. It would be reasonable to assume that the pH in the forest would be lower

Table 1. Transect results comparing *Pinus ponderosa* in ridge and fringe areas.

	Transects	
	Ridge	Fringe
Length of Transects (M)	1170.00	1290.00
Number of Trees	536.00	412.00
Number of Seedlings*	323.00	114.00
Mean Density (M^2)	.15	.09
Mean Age (Years)	56.20	31.30
Mean Diameter (cm)	18.00	15.90
Mean Height (M)	8.30	7.50

*Trees with diameters 4 cm or less at one meter height are termed seedlings.

Table 2. Age and size class of *Pinus ponderosa*.

Size* (cm)	Ridge	Fringe	Age (Years)	Ridge	Fringe
Seedlings**	323	114	Seedlings**	323	114
5-10	147	142	15-25	25	129
11-15	126	110	26-35	121	166
16-20	80	65	36-45	134	85
21-25	73	39	46-55	51	18
26-30	39	30	56-65	97	11
31-35	33	14	66-74	52	2
36-40	21	7	76-85	19	1
41-45	7	3	86-95	15	0
46-50	6	2	96-105	11	0
Totals	859	526		859	526

*Diameter at one meter height.

**Trees with diameters 4 cm or less at one meter height are termed seedlings.

than that of the grassland prairie due to the effects of the pine. This, however, was true in only three of the ten sample sites. The results of the soil sample analysis indicated no significant trends in pH from forest to prairie.

Discussion

At present, northwestern Nebraska is located within the Mixed Prairie vegetational type (Weaver and Bruner, 1954). However, scattered populations of *Pinus ponderosa* occur, the largest being on the Pine Ridge escarpment (Tolstead, 1947). Bessey (1895) stated that the distribution of *P. ponderosa* in Nebraska may have been much greater prior to settlement by white man. Extensive logging practices (Bessey, 1895) and fire (Wells, 1965) appear to be the basic causes of pine tree reduction. If the pines were recently removed, it could be assumed that the pines would begin to encroach into those areas from which it had been removed. This study seems to support this hypothesis since results indicate a reduction in average age of pine trees from ridge to fringe areas. There were also many seedlings encroaching into grassland, especially in areas of soil disturbance or open stands of bunchgrass. Potter and Green (1964) also found evidence of the advancement of pine into grassland areas in western North Dakota emphasizing that encroachment generally occurred in more open prairie areas.

The greatest obstruction to the encroachment of *P. ponderosa* into prairie areas appears to be the prairie vegetation. In this study, seedlings were more abundant in areas of disturbance or in more open grass stands. Tolstead (1947) stated that *P. ponderosa* is absent in some fringe areas due to inability of pine seedlings to compete with mixed prairie grasses. On the other hand, he found some trees present in tracks of old abandoned roads or trails. Potter and Green

(1964) also emphasized a competitive relationship between prairie vegetation (especially the grasses) and *P. ponderosa* indicating that this is a very important factor in pine seedling establishment in prairie areas. This is especially true in regard to soil moisture. They found that many sites in North Dakota would support pines if moisture conditions were proper. In the present study it was found that migration occurred at a faster rate on the east- and north-facing slopes. The probable reason for this is that the prevailing summer winds are from the south and southwest and this would cause the south- and west-facing slopes to be drier. Nixon (1967) in his vegetational study of a small area of the Pine Ridge found the density of pines on north-facing slopes to be three times as great as those on the south-facing slopes.

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DERMACENTOR ANDERSONI IN NATIONAL FOREST RECREATION SITES OF UTAH

C. Selby Herrin[1]

Shortly after the turn of the century, the Rocky Mountain wood tick, *Dermacentor andersoni* Stiles, was recognized as the principal vector of Rocky Mountain spotted fever in western North America. The presence of *D. andersoni* in the recreational sites of the foothills, canyons, and mountains of Utah still offers a potential threat to the health of man. Expanding human population and increased use of recreational facilities enhances this potential. The objective of this study was to determine the prevalence of adult ticks of *D. andersoni* in the recreational sites of Utah.

The Rocky Mountain wood tick is known from northern New Mexico, northern Arizona, northeastern California, Nevada, Utah, western Colorado, western Nebraska, western South Dakota, southwestern North Dakota, Wyoming, Montana, Idaho, northeastern Oregon, eastern Washington, and southern British Columbia, Alberta and Saskatchewan (Hooker, 1909; Bishopp, 1911; Hunter and Bishopp, 1911; Cooley, 1938; Bishopp and Trembley, 1945; Gregson, 1956). In Utah it has been reported from every county except Carbon County (Banks, 1908; Hunter and Bishopp, 1911; Edmunds, 1948, 1951; Coffey, 1953, 1954; Beck, 1955). Other records in the Department of Zoology and Entomology of Brigham Young University show collections from Carbon County, as well as all other Utah counties.

Much information relative to the distribution, ecology, and biology of *D. andersoni* and its relationship to Rocky Mountain spotted fever has been published by scientists working on the control of the wood tick and spotted fever in western Montana and Canada. Although the literature is replete with such reports, only the major works and those related directly to this study are cited in the "Results and Discussion" section of this paper.

Grateful acknowledgment is made to Dr. Dorald M. Allred for valuable suggestions and help given during this investigation, and to Dr. D Elden Beck and Dr. Glen M. Kohls for their assistance and criticism of the manuscript. Mr. R. Clark Anderson, Recreation and Lands Staff Officer for the Uintah National Forest, supplied maps and valuable information on the recreational sites in the national forests of Utah. The Department of Zoology and Entomology, Brigham Young University, Provo, Utah, supplied laboratory space, equipment, and supplies.

Methods and Techniques

Ninety-one recreational sites in the seven national forests of Utah were selected for study. Selection was based on geographic location,

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automobile accessibility, elevation, size, and frequency of use as designated by the U. S. Department of Agriculture (1963). Table 1 lists the study areas in each national forest, and their locations are shown in Figure 1.

Recreational sites were visited from the first week in May until the latter part of August in 1964. An unusually late spring, inclement weather, and distance made it difficult to visit most areas more than once, although 30 were visited two or more times. Adult ticks were collected by dragging a four-foot by three-foot white flannel

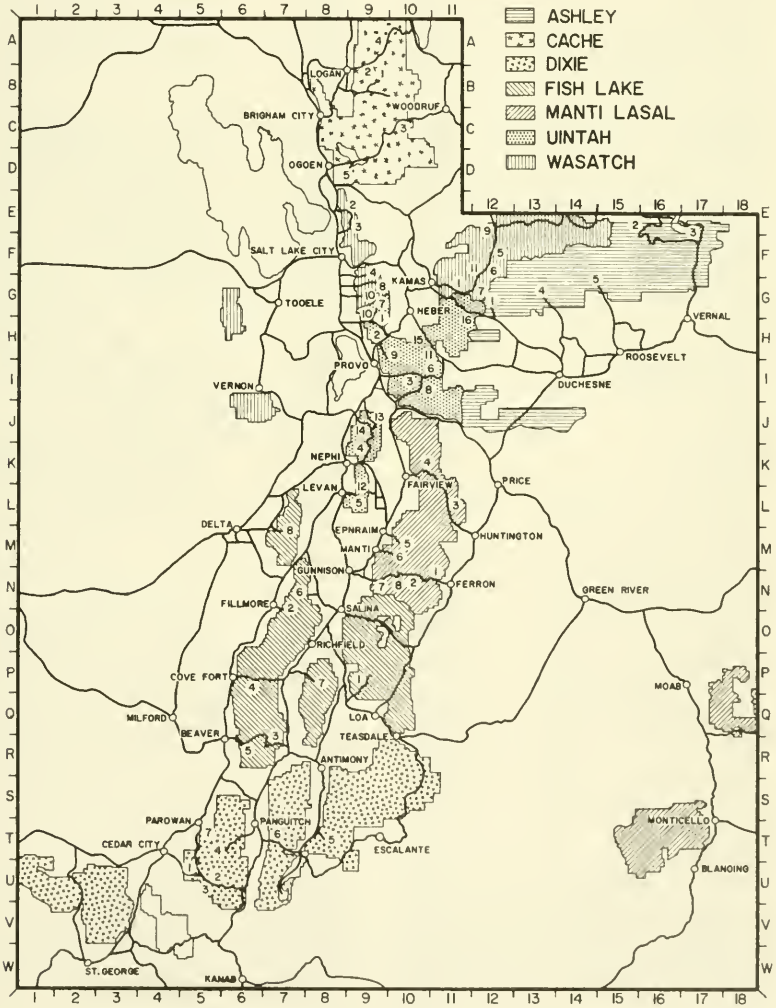

Fig. 1. Location of recreational sites used as study areas in the seven national forests of Utah.

Table 1. Recreational sites used as study areas in the seven national forests of Utah. (Refer to Figure 1 for specific geographic location.)

National forest and recreational site	Map ref. no.	Map coor-dinate	Eleva-tion	Plant community
ASHLEY				
Aspen Grove	1	G-12	7,500	Aspen-Spruce
Carmel	2	E-5	6,500	Poplar-Spruce
Green Lakes	3	E-17	7,100	Ponderosa Pine
Greendale	3	E-17	7,000	Ponderosa Pine
Hades Canyon	1	G-12	7,700	Aspen-Spruce
Moon Lake	4	G-13	7,900	Lodgepole Pine-Aspen
Palisades	2	E-5	7,000	Poplar-Ponderosa Pine
Uintah Canyon	5	G-14	7,900	Ponderosa Pine-Aspen
Uintah River	5	G-14	8,000	Ponderosa Pine-Aspen
CACHE				
Friendship	1	B-9	6,000	Box Elder-Oak
Guinavah	2	B-9	5,400	Willow-Box Elder
Malibu	2	B-9	5,300	Willow-Box Elder
Monte Cristo	3	C-10	8,400	Fir-Aspen
Red Banks	4	A-9	6,500	Aspen-Willow
Spring	1	B-9	6,000	Box Elder-Oak
The Maples	5	D-8	6,200	Spruce-Fir
Wildcat	5	D-8	6,200	Spruce-Fir
Wood Camp	4	A-9	5,600	Box Elder-Willow
DIXIE				
Cedar Canyon	1	U-5	8,000	Spruce-Fir
Duck Creek	2	U-5	8,500	Aspen-Spruce-Fir
Navajo Lake	3	U-5	9,000	Spruce-Fir
Panguitch Lake	4	T-5	6,400	Ponderosa Pine
Pine Lake	5	T-8	7,800	Ponderosa Pine
Red Canyon	6	T-7	7,100	Ponderosa Pine-Juniper
Spruce	3	U-5	9,000	Spruce-Fir
Vermillion	7	T-5	6,600	Poplar-Spruce
FISH LAKE				
Bowery	1	P-9	8,800	Aspen
Buckskin Charley	2	N-7	6,100	
City Creek	3	R-7	7,600	Aspen-Poplar
Fish Creek	4	P-6	6,000	Poplar-Oak
Kents Lake	5	R-6	7,900	Ponderosa Pine-Oak
Mackinaw	1	P-9	8,800	Aspen
Maple Grove	6	N-7	6,400	Oak-Box Elder
Monrovian Park	7	P-8	6,300	Poplar-Oak
Oak Creek	8	M-7	5,900	Maple-Poplar
Ponderosa	5	R-6	7,000	Ponderosa Pine-Aspen
Shingle Mill	2	N-7	6,000	
Twin Creek	1	P-9	8,800	Spruce-Fir
MANTI-LASAL				
Ferron Canyon	1	N-11	7,000	Poplar-Ash
Ferron Reservoir	2	N-10	9,600	Spruce-Aspen
Forks of Huntington	3	L-11	7,600	Spruce-Fir
Gooseberry	4	K-10	8,400	Spruce-Aspen
Huntington Canyon	3	L-11	7,800	Spruce-Aspen
Lake Hill	5	M-10	8,500	Fir-Aspen
Manti Community	6	M-10	7,400	Evergreen-Aspen
Pinchot	7	N-9	7,000	Juniper-Oak
Twelve Mile	8	N-10	9,800	Spruce
Willow Lake	2	N-10	9,000	Spruce-Aspen

Table 1 (continued)

National forest and recreational site	Map ref. no.	Map coordinate	Elevation	Plant community
UINTAH				
Altamont	1	H-9	7,200	Aspen-Spruce
Aspen Grove	2	H-9	6,800	Aspen-Poplar-Evergreen
Balsam	3	T-10	6,000	Maple-Fir
Bear Canyon	4	K-9	6,800	Poplar
Bench	2	H-9	6,800	Aspen-Poplar-Evergreen
Chicken Creek	5	L-9	6,200	
Cottonwood	4	K-9	6,400	Poplar
Dip Vat	6	I-10	7,000	Spruce-Aspen
Granite Flat	7	G-9	6,800	Spruce-Poplar
Hawthorn	8	I-10	6,000	Willow
Hope	9	H-10	6,600	Box Elder-Oak
Little Mill	10	G-9	6,000	Box Elder-Poplar
Lodgepole	11	H-10	7,800	Lodgepole Pine-Aspen
Maple Canyon	12	L-9	6,800	Poplar-Oak
Mile Rock	10	G-9	6,400	Box Elder-Poplar
Mutual Dell	1	H-9	6,600	Spruce-Fir
Payson Lakes	13	J-9	8,000	Aspen
Pines	4	K-9	6,200	Ponderosa Pine-Poplar
Roadhouse	10	G-9	6,200	Box Elder-Poplar
Silver Lake Flat	7	G-9	7,400	Spruce-Fir
Summit	1	H-9	8,000	Aspen
Timpooneke	1	H-9	7,400	Spruce-Aspen
Tumbolt Park	14	J-9	6,200	Evergreen-Box Elder
Warnick	10	G-9	6,200	Box Elder-Poplar
Whiskey Springs	15	H-10	6,600	Box Elder-Poplar
Wolf Creek	16	H-11	9,600	Fir
WASATCH				
Beaver Creek	1	G-11	7,400	Lodgepole Pine-Aspen
Bountiful Peak	2	E-9	7,500	Evergreen-Aspen
Buckland Flat	3	E-9	6,900	Aspen-Oak
Clover Springs	4	F-9	6,900	Evergreen-Aspen
Fir Crest	4	F-9	6,800	Evergreen-Aspen
Hayden's Fork	5	F-12	9,000	Lodgepole Pine-Aspen
Main Boxelder	4	F-9	5,800	Box Elder-Oak
Mirror Lake	6	F-12	10,200	Spruce-Lodgepole Pine
Soapstone	7	G-12	8,000	Lodgepole Pine-Aspen
South Boxelder	4	F-9	5,700	Box Elder-Oak
Spruce	8	G-9	7,400	Spruce
Stillwater	9	E-12	8,500	Lodgepole Pine-Aspen
Sulphur	5	E-12	9,000	Spruce-Lodgepole Pine
Sunset	2	E-9	8,200	Oak
Tanner's Flat	10	G-9	7,100	Aspen
Terrace	4	F-9	6,200	Evergreen-Maple
Trial Lake	11	F-12	10,000	Spruce-Lodgepole Pine

cloth slowly over the vegetation. Specimens adhering to the cloth were picked off, and transported to the laboratory in an ice cooler. Each collection was standardized by correlating the time spent flagging with the number of ticks collected. Consequently, relative populations are indicated on the basis of numbers of specimens collected per hour. The habitat from which ticks were taken was classified as to plant type, size, cover, and age. Vegetation types were categorized

as (1) grass, (2) grass and/or herbs, and (3) grass and/or herbs and short shrubs. The vegetation sizes were arbitrarily designated as (1) short, less than 6 inches, (2) medium, six to 12 inches, and (3) tall, 12 to 24 inches. Designations for the degree of vegetative cover were (1) scanty, less than 25% cover, (2) sparce, 25% to 50% cover, (3) medium thick, 50% to 75% cover, and (4) thick, 75% to 100% cover. The age of the vegetation was considered in the three categories of (1) young, (2) seed head stage, and (3) the drying or dry stage.

Results and Discussion

distribution

All the recreational sites from which *D. andersoni* adults were taken lie along the slopes of the Wasatch and Uintah Mountains, and in the Colorado Plateau country of southern Utah. Coffey (1953) noted a similar mountainous distribution for *D. andersoni*, but in other parts of the Great Basin this tick was uncommon.

Three hundred fifty-eight adult *D. andersoni* (135 males and 223 females) were collected in 115 attempts. The highest population was 60 per hour at Kents Lake in Fish Lake National Forest. The next highest were 52.5 at Manti Community in Manti-Lasal National Forest, and 52 several miles north of Payson Lakes in Uintah National Forest. Populations above 25 per hour were also observed in six other areas (Table 2). The average collection rate for all attempted

Table 2. Tick population density based on collection rates per hour for all collections. Areas where no ticks were found are omitted (see Table 1).

National forest and recreational site	Date	Population density		
		Males	Females	Total
ASHLEY				
Moon Lake	16 July	0	1.7	1.7
Uintah River	15 July	2	0	2
CACHE				
Friendship and Spring	7 July	4	4	8
Guinivah and Malibu	8 July	0	1.2	1.2
Wood Camp	8 July	3	0	3
DIXIE				
Cedar Canyon	3 June	4	8	12
Pine Lake	3 June	0	2.4	2.4
Red Canyon	3 June	3	3	6
Vermillion	3 June	12	24.3	46.3
FISH LAKE				
Bowery	4 June	2.2	2.2	4.4
Buckskin Charley and Shingle Mill	2 June	6	0	6
City Creek	2 June	24	21	45
	28 July	1.7	8.6	10.3
Fish Creek	2 June	4	16	20
Kents Lake	2 June	26	34	60

Table 2 (continued)

National forest and recreational site	Date	Population density		
		Males	Females	Total
Mackinaw	4 June	0	1.7	1.7
Maple Grove	4 June	5.3	8	13.2
Monrovian Park	2 June	10.3	20.6	30.9
Oak Creek	2 June	0	7.5	7.5
Ponderosa	2 June	16.8	24	40.8
MANTI-LASAL				
Lake Hill	10 July	1.7	6.9	8.6
Manti Community	10 July	22.5	30	52.5
Pinchot	10 July	8	10	18
UINTAH				
Altamont	25 June	6	12	18
Aspen Grove	25 June	3	7.5	10.5
	23 July	2.4	0	2.4
Balsam	6 May	2	0	2
	27 May	4.4	3.2	7.7
	23 July	0	1.7	1.7
Bear Canyon	28 May	0	2.2	2.2
Bench	25 June	0	12	12
Chicken Creek	4 June	4	0	4
Cottonwood	28 May	4.8	4.8	9.6
Granite Flat	26 May	5.3	9.3	14.7
	25 June	4.5	3	7.5
Hawthorn	27 May	3	9	12
Little Mill	26 May	1.3	5.3	6.6
Maple Canyon	10 July	4	4	8
Mile Rock and Warnick	3 July	4	0	4
Mutual Dell	25 June	8	12	20
North of Payson Lakes	28 May	26	26	52
Pines	6 May	4	0	4
	28 May	2.6	8	10.6
Silver Lake Flat	25 June	3	12	15
Timpooneke	25 June	8	22	30
	23 July	2	0	2
Tumbolt Park	10 July	4	4	8
Whiskey Springs	10 June	8	12	20
WASATCH				
Beaver Creek	14 July	0	8	8
Buckland Flat	16 June	0	10.5	10.5
Fir Crest and Clover Spring	8 July	3	0	3
Soapstone	22 August	0	1.7	1.7
Sunset	7 July	0	2.4	2.4
Tanner's Flat	12 June	2	2	4

collections was 6.8 per hour. The population density data presented in Table 2 indicate a considerable variation in tick populations at different sites. When ticks were collected in high numbers they were generally found concentrated in small areas. These variations probably are due to differences in biotic and abiotic factors present at different sites. Cooley (1932) indicated that the reason ticks are very abundant in one spot and not in another is that nymphal ticks are dropped and molt in a particular spot, and the new adults remain in this spot to wait for a passing host. However, Cooley (1932) and

Philip (1937) observed ticks to crawl "considerable" distances and become "moderately" concentrated along game trails and other areas where hosts are most likely to be encountered.

The state was arbitrarily divided latitudinally into three sections: (1) a south part consisting of the Dixie and Fish Lake National Forests; (2) a middle part consisting of the Manti-Lasal and Uintah National Forests; and (3) a north part consisting of the Ashley, Wasatch, and Cache National Forests (Figure 1). The average population densities in these sections were 12.2 per hour in the south section, 8.6 in the middle, and 1.6 in the north. Based on number of collections, Coffey (1953) and Beck (1955), however, showed the wood tick to be more abundant in the northern half of the state. Their records reveal that although almost twice as many adults were collected from the northern half than from the southern half of the state, the average number of specimens per collection was 4.0 in the northern half and 8.2 in the southern half. More collection attempts likely were made by them in northern than in southern areas; thus, more collections and consequently more ticks were recorded from northern Utah. Their records support the implications in this study that, where ticks are present, population densities are greater in the southern part of the state.

Highest populations were found between 6,500 and 7,500 feet elevation (Figure 2). No ticks were collected above 8,800 feet. The lower limit was not determined inasmuch as collections were made only as low as 5,500 feet in this study. This elevational distribution corresponds closely with that noted by other workers. Coffey (1954) recorded collections from elevations ranging between 6,000 and 8,000 feet and noted the lack of ticks on animals at 9,000 feet. Beck (1955) noted an abundance of ticks from elevations of 5,500 to 7,000 feet in the mountains surrounding Cedar Valley in Utah County, and in another area in central Utah from elevations of 6,100 to 7,000 feet. Ho (1962) indicated that the wood tick is usually found at elevations above 6,000 feet.

Greater populations were found at higher elevations in southern than in northern Utah (Figure 2). The optimum elevations were 7,000 to 7,500 feet in southern areas and 6,500 to 7,000 feet in northern areas. This latitudinal difference in elevational distribution is also suggested by several notations in the literature. Bishopp (1911) reported the elevational range of *D. andersoni* to be 500 to 9,000 feet, but reaching its greatest numbers between 3,000 and 5,000 feet. His report dealt primarily with studies conducted in western Montana. Bishopp and King (1913) recorded the collection of ticks late in June at 7,200 feet in Colorado and at 5,500 to 6,500 feet early in July in western Montana. In their studies on Colorado tick fever in western Montana, Burgdorfer and Eklund (1959, 1960) collected wood ticks at elevations of 4,000, 5,000, 5,500, and 6,000 feet. In personal communication, Wilkinson (1954) stated that the Canada Department of Agriculture has records of collections from Baniff, Alberta at over 4,500 feet. Thus, the elevational distribution

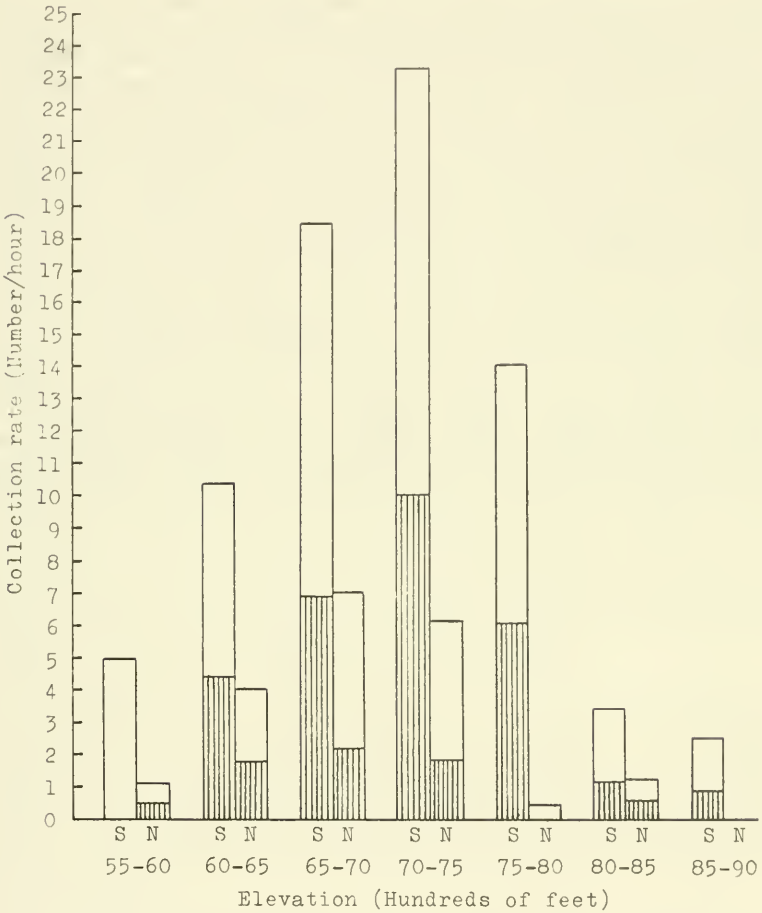

Fig. 2. Relative density of *D. andersoni* adults at various elevations in the southern (S) and northern (N) halves of Utah. Lined columns represent males, unlined columns females.

of the wood tick likely varies with the latitudinal distribution. The optimum elevation becoming lower as one progresses from the southern limits of the range toward the northern limits. Further studies at selected sites dealing specifically with elevational distribution are needed to determine the lower and upper limits of the elevational distribution of the wood tick in relation to latitude.

SEASONAL OCCURRENCE

First attempts to collect ticks were made the first week in May, but inclement weather prevented further attempts until the fourth week in May. Relatively constant surveys were made for the

remainder of the season. Thus, the earliest appearance of ticks in the spring was not determined, but the peak season was from the last week in May to the end of June (Figure 3). A sharp drop in activity occurred the first part of July, and the latest collection made was during the last week in August. Beck (1955) reported the earliest collections in Utah to be near the first of March with the peak season reached about the last week in April and the first week in May. Coffey's (1953) latest records were the first week in September. Analysis of other records in the Department of Zoology and Entomology at Brigham Young University showed the season to be from the first part of March to the first part of September with peak activity in May. Cooley (1932), Gregson (1951), and Beck (1955) indicated that the seasonal occurrence of tick populations in a given locality varies from year to year depending upon the current climatic conditions. In western Montana the first appearance of adults is normally about the middle of March (Bishopp and King, 1913; Cooley, 1932; Philip, 1937). Philip (1937) determined the peak season to be within the two weeks of April 11 to 25. He found that the populations decreased progressively thereafter with a sudden

Fig. 3. Relative density of *D. andersoni* adults during May, June, July and August. Lined columns represent males, unlined columns females.

drop in June and an almost complete disappearance by mid-July. Bishopp and Trembley (1945) reported occasional collections as late as September and October. In Canada, Brown (1944) observed the season to extend from April to August with the peak abundance in May. In British Columbia, Gregson (1951) reported the earliest collections to be the last of February to the first week in March, and the period of peak abundance the last of March to the middle of April with a sudden disappearance by the last of May. The season of greatest activity is later in Utah than in Montana and Canada, and the season in Montana is later than in Canada. The late spring during this study likely is the cause for the unusual lateness of the peak season which was later in southern than in northern Utah. However, further investigations into the seasonal activity at different latitudes are needed to determine the factors which influence such activity.

Seasonal activity early in the spring is correlated with the elevation. Tick populations were greater at lower elevations early in the season and at higher elevations later in the spring. Bishopp and King (1913) recorded the collection of a considerable number of ticks late in June in Colorado at 7,200 feet while finding none at 5,300 feet. They also noted a similar situation early in July in western Montana—ticks were numerous between 5,500 and 6,500 feet but few were found between 3,000 and 4,000 feet. Coffey (1953) observed this in his studies in Utah, as did Burgdorfer and Eklund (1959, 1960) in the studies in western Montana.

Throughout this study, except for the first few collections of the season, female ticks were more predominant than males (Figure 3). The overall sex ratio was two males to three females. Philip (1937) and Gregson (1951) noted that males are predominant early in the season and the females later, but with the overall sex ratio nearly equal. This unequal ratio of sexes in this study probably resulted from a lack of collections early in the season when the males were more abundant.

BIOTIC FACTORS RELATED TO POPULATION DENSITY

In this study the preferred habitats for ticks seeking a host were open, unshaded areas of short, scanty, young grass. Ticks were most abundant in areas with a mixture of grass and herbs at higher elevations, and in grass at lower elevations. Population densities were greater in short vegetation at higher elevations and medium to tall vegetation at lower elevations. The same was evident for vegetative cover—greatest populations were found in scanty to sparse vegetation at higher elevations, and in thick vegetation at lower elevations. The grass does not grow tall and thick until later in the season at the time when populations of ticks begin to decrease. Consequently, the size and age of the vegetation is only an indication of seasonal occurrence. The reason for a greater abundance of ticks on scanty to sparse, short grass and herbs at higher elevations and on thick, taller

grass at lower elevations probably is that these types of vegetation are more characteristic of the respective elevations, and not that the habits of the ticks differ. Cooley (1913, 1932) observed that adults ascended dead vegetation to await the passing of hosts, but indicated that they also will ascend living vegetation as well. Philip (1937) observed many ticks on dead grass and weed stems very early in the spring. However, it is doubtful that the ticks actually prefer dead over living vegetation. Ticks normally would be found on dead vegetation early in the spring before the new vegetative growth is tall enough to afford good waiting positions.

Bishopp (1911) and Cooley (1911, 1932) indicated that the population densities of wood ticks are greatly influenced by the availability of two general classes of hosts—small mammals on which immature stages feed, and large wild and domestic mammals on which the adults feed. Parker (1918), Cooley (1932), Brown (1944), and Gregson (1951, 1956) found ticks in all types of country where proper host animals were present. The types of hosts present were related to the type of vegetation available for sufficient food and cover. The type of vegetation in an area is dependent upon soil and climatic conditions, and other physical factors. Parker, Philip, Davis, and Cooley (1937) found the wood tick to be most abundant in localities where the vegetation was low and brushy with open areas. Gregson (1956) in Canada determined that the most favorable habitat was characterized by talus slopes backed by rocky bluffs where there was sufficient moisture to support vegetation. Beck (1955), Coffey (1953), and Ho (1962) in Utah listed hosts on which each of the stages feeds, and Coffey observed that tick populations were greater in areas where these hosts were most abundant. Wilkinson (1964) suggested that rodent hosts are probably more abundant in camp sites because of the refuse left by campers and picnickers. Such a concentration of hosts may account for the greater populations of ticks in some recreational sites.

ABIOTIC FACTORS RELATED TO POPULATION DENSITY AND ACTIVITY

The activity of ticks increased gradually throughout the day to a high point in the late afternoon. The collection day was divided into four three-hour periods—7 a.m. to 10 a.m., 10 a.m. to 1 p.m., 1 p.m. to 4 p.m., and 4 p.m. to 7 p.m. The collection rates expressed in number per hour for the respective periods were: 4.4, 4.8, 6.5, and 13.4. Slight differences in daily activity at different elevations were noted in this study but probably are not significant. No seasonal change in daily activity was evident. Temperatures taken one foot from the ground at the time of each collection ranged from 12° to 38° C. There was no apparent optimum temperature range for tick activity even though the population densities were slightly higher at some temperatures. Although the average mean temperature increases as the season progresses, this change apparently has little or no affect on tick activity.

Philip (1937) and Brown (1944) noted that ticks were nearly as active at night as during the middle of the day. Brown suggested that ticks should be just as active during the night as the day because it is at night that the host animals are the most active, and the drop in temperature might produce increased activity. Moderate temperature changes apparently have little effect on tick activity. Gregson (1951) failed to find any striking change in tick activity with fluctuations of temperature and humidity. He suggested that the disappearance of ticks later in the season is due to some form of diapause, the cause of which is unknown. Philip (1937) and Brown (1944) observed decreased tick activity during very hot, very cold, and stormy weather. They also noted that ticks did not seek shelter during adverse weather but remained in a more or less inactive state on the vegetation. Bishopp and King (1913) found that tick activity in the spring begins within six to 12 days from the time when the daily mean temperature ranges between 3° and 6° C. for several consecutive days. They also suggested that dormancy is produced in the fall when temperatures range between 9° and 12° C. Mail (1942) determined the lethal temperature for wood ticks to be —10° to —14° C at the lower range and 45° to 46.5° C at the higher range. He also observed that ticks from regions of colder climate and longer winters have a greater resistance to freezing than those from regions of warmer climate and shorter winters. If ticks in colder climates are more resistant to cold and less resistant to heat, it is expected that they would have an earlier season. This may partly explain why the seasonal occurrence in the northern ranges is earlier than in the southern ranges.

In the present study tick activity was slightly greater on partly cloudy to cloudy days than on clear occasions. Cooley (1913, 1932) observed that ticks were stimulated by an abrupt appearance of a shadow or change in light intensity, and suggested that ticks in nature are made aware of an animal by its shadow. As a cloud cuts off the sun light the ticks may be stimulated to activity in a manner similar to the shadow of an approaching animal.

Tick activity increased proportionately relative to an increase in wind velocity, although increased activity could not be related to very strong, gusty winds because the flag was blown from the vegetation and collecting operations were hampered. The average collection rates (expressed in number per hour) were as follows: still days, 5.3; breezy days, 7.5; and windy occasions, 11.2. Cooley (1913), experimenting with ticks in a cage, observed that activity was increased by blowing the breath through the top of the cage. He further suggested that ticks may be informed of the presence of a host by feeling its breath. These observations indicate that ticks are stimulated to activity either by air movement or an increased amount of carbon dioxide in the immediate environment. Thus, on breezy and windy occasions ticks may be stimulated to greater activity by the movement of air and vegetation which may be interpreted as being caused by an approaching animal.

Summary

Three hundred fifty-eight adult *Dermacentor andersoni* (135 males and 223 females) were collected from 48 recreational sites during the spring and summer of 1964. The average collection rate (population density) for all collections was 6.8 per hour, but populations varied between sites. Populations were greater in the middle and southern parts of the state than in the northern. The greatest populations were at elevations between 6,000 and 8,000 feet with the upper limit just under 9,000 feet. The elevational distribution varied with the latitude—greater populations were found at higher elevations in southern than in northern Utah. The season of peak abundance was between the last week of May and the last of June. Populations were greater at lower elevations early in the season and at higher elevations later in the spring. Male ticks were more abundant early in the season, whereas females predominated later. The preferred habitat was open, unshaded areas of short, scanty, young grass. Ticks were collected in greater numbers in the afternoon than in the morning. Temperatures between 12° and 38° C apparently had little effect on tick activity. Activity was slightly greater on partly cloudy to cloudy days than on clear days, and increased proportionately relative to an increase in wind velocity.

Even with the present knowledge of *D. andersoni* in western North America, much yet remains to be learned about the biology and ecology of this important vector of Rocky Mountain spotted fever.

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AMETROPROCTUS A NEW GENUS OF CHARASSOBATID MITES FROM THE UNITED STATES.. (ACARI: CRYPTOSTIGMATA: CHARASSOBATIDAE)

Harold G. Higgins[1] and Tyler A. Woolley[2]

Soil mites of the family Charassobatidae have been recorded previously from south and central America and New Zealand. In collections taken by the authors mainly in Utah and Colorado is a previously undescribed genus and species that is tentatively placed in this family. This new genus differs from other known charassobatids in having three claws and very large anal and genital apertures. It is placed in this family because of the large, projecting lamellae, the type of body setae, and the number of genital and anal setae. Limited collecting indicates that this new genus may be widespread in the mountains of western North America. A description of the genus and species follow below.

Ametroproctus n. gen.
(Figs. 5, 6)

Lamellae large, extending over top of rostrum with a translamellae; lamellar and rostral hairs simple or feather-like; interlamellar hairs simple, small with tiny insertions; dorsosejugal suture distinct; dorsal setae small, inconspicuous, simple; sensillus clavate; large genital and anal apertures with four pairs of genital setae and two pairs of anal setae; legs heterotridactylus; hysterosoma tapered posteriorly; body covered with dense cerotegument. The generic name refers to the large anal aperture.

Ametroproctus oresbios n. sp.

Description: Propodosoma about as long as wide; rostrum rather blunt, not visible from above; rostral hairs fine, simple; lamellae large, covering most of propodosoma, projecting beyond rostral tip; lamellar hairs simple; interlamellar hairs simple, small with tiny insertions located near level of exobothridial hairs; pseudostigmata cup-like directed up and out; sensillus clavate with a narrow pedicle and expanded setose head; dorsosejugal suture distinct, arched.

Hysterosoma generally oblong in outline tapering toward the posterior end; surface covered with a heavy cerotegument that hides the dorsal setae; dorsal surface as shown in Fig. 5.

Camerostome egg-shaped; ventral setae and apodemata as shown in Fig. 6; genital opening large, each cover with four setae; anal

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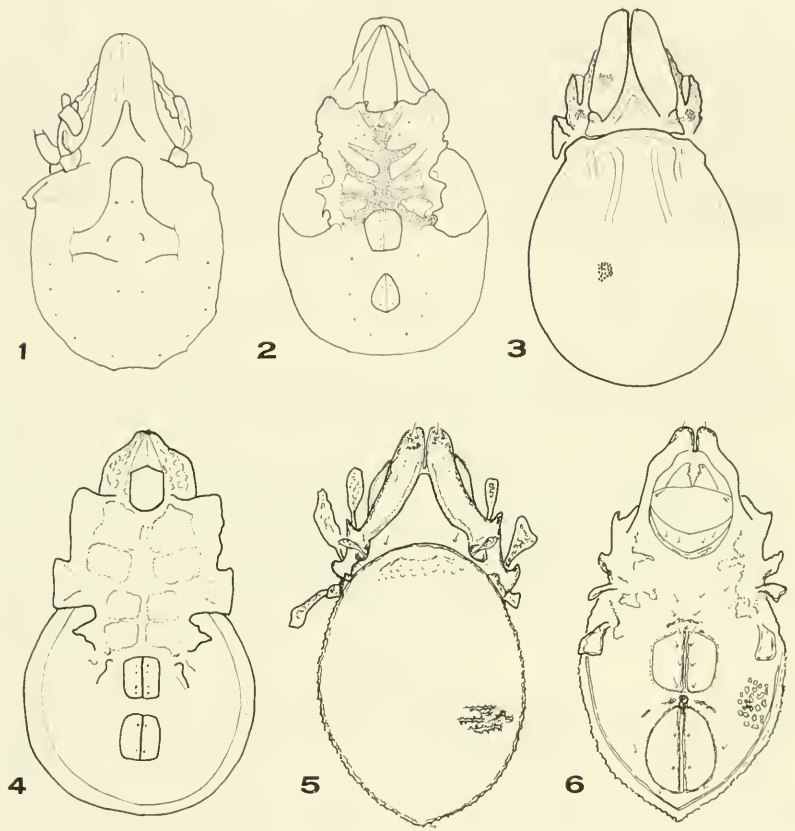

Figs. 1-2. *Charassobates cavernosus* Grandjean, 1929. Figs. 3-4. *Topalia problematica* Balogh and Csiszar, 1963. Figs. 5-6. *Ametroproctus oresbios* n. gen., n. sp.

opening large, pear-shaped, located close to genital opening with two simple setae on each cover; internal preanal piece present; heavy sclerotized bar between genital and anal plates at level of preanal piece; ada_1 posterior to anal plate; ada_2 lateral near middle of genital plate; fissure *iad* near anterior end of anal plate below sclerotized band.

Legs heavy, shorter than body, each with three unequal claws.

Size: length 645μ; hysterosoma 420μ; width 390μ.

Locality: The type and four paratypes taken from moss at Alta, Utah, 2 Sept., 1954 by H. Higgins; 1 specimen from Diamond Fork Canyon, Utah 17 June 1965 by H. Higgins; 3 specimens from lichens and moss at Ward, Colorado, 13 Sept., 1958 by T. A. Woolley; 2 specimens from moss on Half Hill at Bellevue, Colorado, 4 August

1965 by T. A. Woolley; 1 specimen from Cle Elum, Washington, 19 August 1956 by H. and M. Higgins.

Discussion: The small sample of this new mite shows considerable variation in the size and length of the rostral and lamellar hairs, in the size and location of the translamellae, as well as in the amount of arching of the dorsosejugal suture. In two additional broken specimens the rostral and lamellar hairs are distinctly feather-like. Additional collection and studies are needed to show if these differences warrant the description of an additional species.

Artificial Key to Known Genera

1. Genital and anal plates small; hysterosoma rounded posteriorly; legs with one claw 2

1. Genital and anal plates large; hysterosoma pointed posteriorly; legs with three claws ..... *Ametroproctus* n. gen.

2. Dorsosejugal suture indistinct; sensillus spatulate; anal aperture diamond shaped ..... *Charassobates* Grandjean, 1929

   Dorsosejugal suture distinct; sensillus with distinct head; anal aperture with nearly parallel sides ..... *Topalia* Balogh and Csiszar, 1963

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NOTE

THE ERMINE IN WESTERN UTAH[1]

Specimens of the ermine, *Mustela erminea* Linnaeus, from Utah are scarce, and it is still not possible to accurately delimit the geographical and ecological range of this mustelid within the state. Durrant (*Mammals of Utah,* University of Kansas Publ. Mus. Nat. Hist., 6:1-549, 1952) defined its range as "limits unknown, probably occurs throughout the state in the high mountains." The six published records, including two available to Durrant, are summarized according to county as follows: UTAH CO., 1 ♂ and 1 ♀ (C. L. Hayward, J. Mamm., 30: 436-37, 1949); 1 ♀ (S. D. Durrant, *op. cit.*). GARFIELD CO., 1 sex unknown (S. D. Durrant, *op. cit.*). WASATCH CO., 1 ♂ (S. Anderson, J. Mamm., 36:568, 1955). DAGGETT CO., 1 ♀ (H. J. Egoscue, J. Mamm., 38:410, 1957).

Two ♂ ermines were captured 27 September and 1 October 1966 in South Willow Creek Canyon, Stansbury Mountains, TOOELE CO., elevation 7500 ft. by Lowry; these constitute the first known records of occurrence in the Bonneville Basin. The closest locality of capture to the west is Baker Creek, WHITE PINE CO., NEVADA (E. R. Hall, *Mammals of Nevada,* University of California Press, Berkeley and Los Angeles, 1946) about 135 air miles southwest of the Stansbury Mountains. The nearest locality to the east is Mt. Timpanogos, UTAH CO. C. L. Hayward, *op. cit.*) some 45 air miles distant.

Our weasels were caught alive in tin-can traps baited with grain and set for rodents. Vegetation in the immediate and nearby vicinity consisted of Douglas fir, *Pseudotsuga menziesii;* maple, *Acer* sp.; chokecherry, *Prunus virginiana;* and wild rose, *Rosa* sp. with a heavy understory of herbaceous plants and grasses. Both captures were made either during or shortly after a rain storm. The only other small mammals collected here were deer mice, *Peromyscus maniculatus,* but in the canyon bottom nearby other traplines yielded long-tailed voles, *Microtus longicaudus;* water shrews, *Sorex palustris;* wandering shrews, *Sorex vagrans;* and the Uintah chipmunk, *Eutamias umbrinus.*

Both ermines were in brown summer pelage but began the change to white winter pelage about 2 October. The smallest ♂ died 14 January 1967 of unknown causes while in winter pelage and was prepared as a specimen. Ecology and Epizoology Research No. 16712. Conventional measurements in mm. were: 220 - 58 - 29 - 8; weight 32.1 g.

On geographic grounds and because of its small size this specimen is referred to the subspecies *Mustela erminea muricus* (Bangs).—Elbert J. Lowry[2] and Harold J. Egoscue[2].

1. The work was accomplished under Dugway Proving Ground U. S. Army Research and Development Contract No. DA-42-007-AMC-227(R) with the University of Utah and reported as Ecology and Epizoology Research Contribution No. 139.

2. Ecology and Epizoology Research, University of Utah, Dugway, Utah 84022.

BOOK NOTICE

Taxonomic Review: Miridae of the Nevada Test Site and the Western United States. By Harry H. Knight. Brigham Young Univ. Sci. Bull., Biol. Ser., IX, (3):1-282, 318 text-figs., 1968.

This work is an exhaustive treatise of the mirids of the Nevada Test Site which is located about 70 miles northwest of Las Vegas, Nevada, in the southeastern part of Nye County. The area is approximately 1,300 square miles in size. It is included in the Las Vegas Bombing and Gunnery Range which consists of about 4,000 square miles.

Dr. Knight has summarized his study as follows: "Approximately 5,000 specimens of plant bugs were collected at the Nevada Test Site between 1959

and 1965. Greatest emphasis was given to collecting from June 10-24, 1965, when the desert areas at the test site were unusually profuse with blooming vegetation. A total of 160 species representing 50 genera was taken at the test site. Of these, 7 genera and 96 species are new to science.

"Comparative data for these and additional species from other parts of Western North America are also included. These represent an additional 449 species, of which 5 genera and 148 species are new to science. Altogether, 612 species of 122 genera are included in taxonomic kegs to the subfamilies, genera, and species of Western North America, including a total of 245 new species.

"Distribution data are provided for each species, and host plant relationships are designated when known."

This study was dedicated by Dr. Knight to the memory of the late Dr. D Elden Beck, who with Dr. Dorald M. Allred were the project supervisors of the United States Atomic Energy Commission contracts AT(11-1)1326 and AT(11-1) 1355, 1962-1966—V.M.T.

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ANNOTATED BIBLIOGRAPHY OF NEVADA ORNITHOLOGY SINCE 1951

Richard C. Banks[1]

The most recent list of birds of Nevada, necessarily incorporating a review of the literature up to that time, is that published by Linsdale in 1951. The extensive amount of new information on Nevada birds since Linsdale's summary has been published in a variety of books and journals. This compilation of references is a by-product of an effort to determine the status and distribution of certain birds in Nevada. It is presented with the hope that others who develop ornithological interests in that state will be spared the effort of compiling their own lists.

This list of annotated citations is presented with no claim that it is complete. No attempt has been made to ferret out all systematic reviews of species which may more or less casually mention a specimen from the state; although some such papers have been included, undoubtedly many others have been overlooked. Most mimeographed and "popular" publications have not been included.

Two references included here predate Linsdale's 1951 paper. One (Hardy, 1949) was apparently overlooked by Linsdale; the other (Pulich and Phillips, 1951) appeared in print while Linsdale's paper was in press.

Gordon W. Gullion graciously studied the original list of references which I had compiled and drew my attention to several others. His efforts are deeply appreciated.

This list includes no papers published after December 31, 1967.

Aldrich, John W.

1951. A review of the races of the Traill's flycatcher. Wilson Bull. 63:192-197. Type specimen of *Empidonax traillii brewsteri* from Cloverdale, Nev., considered a migrant of Pacific northwest population; breeding birds from southern Great Basin assigned to *E. t. extimus*.

1967. Taxonomy, distribution and present status. Pp. 17-44 *in* The Wild Turkey and Its Management. Oliver H. Hewitt, ed. The Wildlife Society, Washington, D. C. Table gives population estimates of *Meleagris gallopavo merriami* in Nev., 1961-1965.

1. Bureau of Sport Fisheries and Wildlife; U. S. National Museum, Washington, D. C.

Aldrich. John W., and Allen J. Duvall
1955. Distribution of American gallinaceous game birds. Circular 34, Fish and Wildlife Service, Washington, D. C. Range maps.
1958. Distribution and migration of races of the mourning dove. Condor 60:108-128. Specimens of *Zenaidura macroura marginella* from Nev.

Alcorn, J. R.
1953. Food of the common merganser in Churchill County, Nevada. Condor 55:151-152.

Alcorn, J. R., and Frank Richardson
1951. The chukar partridge in Nevada. Jour. Wildl. Mgt. 15: 265-275. Introduction, establishment, and biology.

Amadon, D.
1966. Confused nocturnal behavior of (? California) gulls. Condor 68:397-398. Observation near Reno; comments on Lake Tahoe area; April, 1964.

American Ornithologists' Union
1957. Checklist of North American Birds. Fifth edition.

Audubon Field Notes.
Nearly every issue of this journal, published by the National Audubon Society, contains information on birds in Nevada.

Austin, George T., and W. Gren Bradley
1955. Bird records from southern Nevada. Condor 67:445-446. *Dendrocygna bicolor*—first record (spec.) for southern Nev.; *Sphyrapicus varius daggetti; Toxostoma bendirei*—fourth record (spec., juv.); all Clark Co.
1966. Additional records for uncommon birds in southern Nevada. Great Basin Nat. 26:41-42. *Florida caerulea; Aythya marila*—sight rec., March, 1964; *Gallinula chloropus; Mniotilta varia; Setophaga picta*—second record (sight), Colorado River, April, 1963; *Spiza americana;* all Clark Co.

Banks, Richard C.
1964. Geographic variation in the white-crowned sparrow *Zonotrichia leucophrys*. Univ. Calif. Publ. Zool. 70. 123 pp. Nev. breeding populations discussed; subspecific name *Z. l. leucophrys* considered correct instead of *Z. l. oriantha*.

Banks, Richard C., and R. Guy McCaskie
1964. Distribution and status of the Wied crested flycatcher in the lower Colorado River Valley. Condor 66:250-251. Mention of Nev. records of *Myiarchus tyrannulus magister*.

Behle, William H.
1956. A systematic review of the mountain chickadee. Condor 58:51-70. *Parus gambeli abbreviatus* in northwestern Nev., *P. g. inyoensis* in most of rest of state.

Behle, William H., and Robert K. Selander
1951. A new race of dusky grouse (*Dendragapus obscurus*) from the Great Basin. Proc. Biol. Soc. Wash. 64:125-128. New race *D. o. oreinus* resident in Snake Range, Ruby Mountains, and Toyabe Range of Nevada; list of Nev. specimens examined.

Bond, Gorman M.
1963. Geographic variation in the thrush *Hylocichla ustulata*. Proc. U. S. Nat. Mus. 114:373-387. Nev. breeding specimens assigned to *H. u. almae;* discussion of type of this race, from Nev.

Bump, Gardiner, and Wayne H. Bohl
1964. Summary of foreign game bird propagation and liberations 1960 to 1963. Spec. Sci. Report Wildlife no. 80, Bureau of Sport Fisheries and Wildlife. Includes details of introduction of *Francolinus francolinus asiae*, *Francolinus pondicerianus interpositus*, *Pterocles exustus hindustan*, *Phasianus colchicus bianchii*, and *Tetraogallus himalayensis* in Nev.

Bureau of Fisheries and Wildlife
1956. Birds of Ruby Lake National Wildlife Refuge. Refuge Leaflet 156. Mimeo. 3 pp.

1967. Ruby Lake National Wildlife Refuge. Refuge Leaflet 98-R. Mimeo. 6 pp. Mentions several common birds; trumpeter swans "well established at Ruby Lake and have spread out to other areas in northeastern Nevada."

1967. Birds of the Desert National Wildlife Range. Refuge Leaflet 132-R-3. Mimeo. 4 pp. Seasonal status of 236 species, with list of 19 others "recorded only once or twice." Many important records, but not documented. List largely represents work by, and is compilation of, Dr. Charles G. Hansen, refuge biologist.

Burleigh, Thomas D.
1960. Geographic variation in the western wood pewee (*Contopus sordidulus*). Proc. Biol. Soc. Wash. 73:141-146. Nev. pewees assigned to *Contopus sordidulus veliei;* = *C. virens richardsonii* of Linsdale's 1951 list.

1960. Three new subspecies of birds from western North America. Auk 77:210-215. A specimen of *Sitta canadensis* from Nev. assigned to new race *S. c. clariterga.*

Chambers, Glenn D.
1965. Summary of foreign game bird propagation; 1964, and liberations; 1960-1964. Supplement to Special Scientific Report—Wildlife no. 80, Bureau of Sport Fisheries and Wildlife, Washington, D. C. Data on release, and results, of *Francolinus francolinus asiae*, *Francolinus pondicerianus interpositus*, *Pterocles exustus hindustan*, and *Tetraogallus himalayensis;* supplements Bump and Bohl, 1964.

1966. Summary of foreign game bird propagation 1965, and liberations 1960-1965. Supplement to Special Scientific Report—

Wildlife no. 80, Bureau of Sport Fisheries and Wildlife, Washington, D. C.
Data as in Chambers, 1965, with addition of *Phasianus colchicus bianchii* and "Afghan white-winged pheasant ringneck cross"; supplements Bump and Bohl, 1964, and Chambers, 1965.

Christensen, Glen C.
1954. The chukar partridge in Nevada. Nevada Fish and Game Comm., Biol. Bull. 1. 77 pp. Distribution, life history, and management.
1958. The effects of drought and hunting on the chukar partridge. Trans. 23rd North Amer. Wildl. Conf. :329-341. Correlation between range conditions and chukar production.
1963. Sand grouse released in Nevada found in Mexico. Condor 65:67-68. Details of release of *Pterocles exustus hindustan* in Nev. in 1960 and 1961.

Christensen, Glen C., and Wayne H. Bohl
1964. A study and review of the common Indian sandgrouse. Spec. Sci. Report Wildlife no. 84, Bureau of Sport Fisheries and Wildlife. Includes details of introductions of *Pterocles exustus hindustan* in Nev.

Cottam, Clarence
1954. Bird records for Nevada. Condor 56:223-224. *Aegolius acadicus*, *Ixoreus naevius*, and *Dendroica townsendi*, Clark Co.

Crispens, Charles G., Jr.
1960. Quails and Partridges of North America: A Bibliography. Univ. of Washington Press, Seattle. 125 pp. Cites many Nev. references.

Crunden, Charles W.
1963. Age and sex of sage grouse from wings. Jour. Wildl. Mgt. 27:846-849. Work done in Nev.

Davis, John
1951. Distribution and variation of the brown towhees. Univ. Calif. Publ. Zool. 52:1-120. Nev. specimens and population of *Pipilo aberti dumeticolus* considered.

Edminster, Frank C.
1954. American Game Birds of Field and Forest. Charles Scribner's Sons, New York. 490 pp. Cites information on several game species from Nev.

Evans, Raymond N.
1967. Nest site movements of a poor-will. Wilson Bull. 79:453.

Evenden, Fred G., Jr.
1952. Additional bird records for Nevada. Condor 54:174. *Falco peregrinus*—nest, Elko Co.; *Charadrius alexandrinus*—first evidence of nesting in Nev., downy young seen, Lyon Co.; *Sphyrapicus thyroideus*—nesting, Elko Co.; *Cyanocitta stelleri*—Lander Co.; *Parus atricapillus*—Churchill Co.; last in 1950, others in 1949, no specimens.

Francis, William J.
1967. Confused behavior of gulls in relation to weather conditions. Condor 69:609. Response to Amadon, 1966.

French, Norman R.
1959. Distribution and migration of the black rosy finch. Condor 61:18-29.

Giles, LeRoy W., and David B. Marshall
1954. A large heron and egret colony on the Stillwater Wildlife Management Area, Nevada. Auk 71:322-325. A colony of an estimated 1,191 nests and three smaller colonies in 1950, with *Nycticorax nycticorax*, *Ardea herodias*, *Leucophoyx thula*, *Casmerodius albus*, and *Plegadis mexicana*; Lahontan Valley.

Gullion, Gordon W.
1952. The Hudsonian curlew in Nevada. Condor 54:62. First record (sight, crippled bird) of *Numenius hudsonicus;* Clark Co., July, 1951.

1952. Recent bird records from southern Nevada. Condor 54: 204. *Aix sponsa*—new record (spec.) for southern Nev., Clark Co.; *Aythya marila*—Clark Co.; *Eupoda montana*—first for southern Nev., Nye Co.; all 1951.

1953. Additional bird records from southern Nevada. Condor 55:160. *Eupoda montana; Scardafella inca*—first record (sight), Clark Co.; *Columbigallina passerina*—first record (spec.), Clark Co., actually second record, cf. Hardy, 1949; *Zonotrichia albicollis*—second record (spec.), Clark Co.; all in 1952.

1956. An ancient murrelet in northeastern Nevada. Condor 58: 163. *Synthliboramphus antiquus*—first record (spec.), Elko, Elko Co., Nov., 1955.

1956. Evidence of double-brooding in Gambel quail. Condor 58:232-234.

1956. The current status of the starling in Nevada. Condor 58:446. *Sturnus vulgaris*—in winter in nearly all parts of state; nesting record near Elko.

1956. Let's go desert quail hunting. Nevada Fish and Game Comm., Biol. Bull. 2. 76 pp. A lot of good biological information written in a narrative, popular style.

1957. Miscellaneous bird records from northeastern Nevada. Condor 59:70-71. *Buteo lagopus*—"the common wintering *Buteo* in this part of the state"; *Sphyrapicus thyroideus*—second record in northeast Nev. (sight); *Parus atricapillus*—second record (sight), eastern Nev.; *Troglodytes troglodytes*—fourth record for Nev., first for eastern part (sight); *Toxostoma rufum*—first record for Nev., (sight, banded), Nov. 1955-April 29, 1956, Eureka Co.; *Bombycilla garrulus; Hesperiphona vespertina*—"common and regular fall and spring visitant in Elko area"; *Leucosticte atrata; Leucosticte tephrocotis*—race *L. t. littoralis* (sight); *Acanthis flammea*—spec.; *Spinus tristis*—Nov. Elko Co.;

Loxia curvirostra; Zonotrichia querula—third record for state, first for northeast, Elko Co., Nov., actually fourth record (cf. Linsdale, 1936, 1951)

1957. Precocial strutting in sage grouse. Condor 59:269. In Elko Co.

1957. Gambel quail disease and parasite investigations in Nevada. Amer. Midl. Nat. 57:414-420.

1960. The migratory status of some western desert birds. Auk 77:94-95. "a total of 23 species (19 percent) among about 120 native birds breeding in Nevada's desert regions spend their winters in the Central American tropics, or farther south."

1960. The ecology of Gambel's quail in Nevada and the arid southwest. Ecology 41:518-536.

1962. Organization and movements of coveys of a Gambel quail population. Condor 64:401-415. Study in Clark Co.

1964. Wildlife uses of Nevada plants. U. S. Nat. Arboretum. Contributions toward a Flora of Nevada, no. 49. 170 pp. Mimeo.

1965. A critique concerning foreign game bird introductions. Wilson Bull. 77:409-414. A discussion with considerable reference to the program in Nev.

Gullion, Gordon W., and Glen C. Christensen

1957. A review of the distribution of gallinaceous game birds in Nevada. Condor 59:128-138.

Gullion, Gordon W., and Ardelle M. Gullion

1961. Weight variations of captive Gambel quail in the breeding season. Condor 63:95-97.

1964. Water economy of Gambel quail. Condor 66:32-40.

Gullion, Gordon W., and Leonard W. Hoskins

1956. Noteworthy bird records from northeastern Nevada. Condor 58:295. *Polioptila caerulea*—nesting, near Elko, northernmost record; *Lanius excubitor*—five records for Elko Co. (2 specs.); *Lanius ludovicianus*—December.

Gullion, Gordon W., Warren M. Pulich, and Fred G. Evenden

1959. Notes on the occurrence of birds in southern Nevada. Condor 61:278-297. An extensive list of species, but admittedly not complete, of birds in the Mohave Desert region of Nev. Records included are: *Lophodytes cucullatus*—record for southern Nev. (sight); *Cathartes aura*—first winter record for state, Jan. (sight); *Zenaida asiatica*—apparently extending range; *Asyndesmus lewis*—spring records; *Dendrocopos pubescens*—first record for southern Nev. (sight); *Myiarchus tyrannulus*—second record in Nev., first outside Colorado River drainage (sight); *Progne subis*—first records since 1868; *Toxostoma bendirei*—second and third records for state (spec., sight); *Toxostoma curvirostre*—first for Nev. (sight); *Hylocichla ustulata*—first record for southern Nev. (sight, banded); *vermivora rufi-*

capilla—second record in southern Nev. (sight); *Zonotrichia atricapilla*—fourth record for state, first in southern Nev. (spec.)

Hardy, Ross
1949. Ground dove and black-chinned sparrow in southern Nevada. Condor 51:272-273. *Columbigallina passerina*—first record for Nev. (sight), Clark Co., 1945; *Spizella atrogularis*—breeding, Lincoln Co.; reference not cited by Linsdale, 1951, and apparently overlooked also by Gullion, 1953.

Hayward, C. Lynn, Merlin L. Killpack, and Gerald L. Richards
1963. Birds of the Nevada test site. Brigham Young Univ. Sci Bull., Biol. Ser. 3(1):1-27. Comments on collection records and status for "about 192 kinds of birds" in southern Nye Co.; six new records for Nevada, three of species, three of subspecies, all based on specimens, are: *Pluvialis dominica dominica; Erolia melanotos; Hylocichla guttata oromela; Hylocichla ustulata ustulata; Carpodacus purpureus californicus; Calcarius lapponicus lapponicus;* comments on other unusual species are for: *Micropalama himantopus; Tyrannus vociferans; Dumetella carolinensis; Zonotrichia atricapilla.*

Hickey, Joseph J.
1951. Mortality records as indices of migration in the mallard. Condor 53:284-297. Some data from Nev.

Hoskins, Leonard W.
1953. Sight record of yellow-shafted flicker in south Idaho. Murrelet 34:48. The bird was on a fence post making the boundary of Nev. and Idaho.

Howard, Hildegarde
1958. An ancient cormorant from Nevada. Condor 60:411-413. Bones from cave in Pershing Co. identified as *Phalacrocorax auritus*, similar to present northwestern population of the species.

Howell, Thomas R.
1952. Natural history and differentiation in the yellow-bellied sapsucker. Condor 54:237-282. Distribution of *Sphyrapicus varius nuchalis* and *S. v. daggetti* in state.

Johnson, Ned K.
1952. Additional records of the rough-legged hawk in Nevada. Condor 54:65. *Buteo lagopus* widespread winter visitant in northern part of state.

1953. Dipper eaten by brook trout. Condor 55:158.

1954. Food of the long-eared owl in southern Washoe County, Nevada. Condor 56:52.

1954. Notes on some Nevada birds. Great Basin Nat. 14:15-18. *Melanitta deglandi; Falco columbarius; Charadrius hiaticula semipalmatus*—fall spec.; *Totanus melanoleucus; Erolia alpina; Limnodromus scolopaceus; Ereunetes mauri*—March record; *Tyto alba; Dendrocopos albolarvatus*—first reports since 1889.

Lake Tahoe and Reno (sight); *Thyromanes bewickii; Bombycilla garrulus*—Reno; *Bombycilla cedrorum; Amphispiza bilineata*—early spring dates; many of above are county records.

1956. Birds of the piñon association of the Kawich Mountains, Nevada. Great Basin Nat. 16:32-33.

1956. Recent bird records for Nevada. Condor 58:449-452. *Parabuteo unicinctus*—second record in Nev. (sight), Clark Co.; *Catoptrophorus semipalmatus*—first (actually second, cf. Marshall and Alcorn, 1952) nesting record in state; *Glaucidium gnoma californicum*—first record (spec.) for state, several localities in Carson Range; *Dendrocopos scalaris cactophilus; Sayornis nigricans semiatra*—first breeding record in state (spec.), Lincoln Co.; *Empidonax difficilis difficilis; Hylocichla guttata*—first records of *H. g. slevini* in Nev. (specs.); *Regulus satrapa; Vermivora luciae*—range extension to north; *Dendroica occidentalis*—summer resident; *Leucosticte tephrocotis*—first records of *L. t. dawsoni* and second record of *L. t. wallowa* in Nev. (specs.), Washoe Co.; *Leucosticte atrata*—winter record, Washoe Co. (specs.); *Passerella iliaca*—first records of *P. i. sinuosa* and *P. i. unalaschensis* and second records of *P. i. fulva* and *P. i. olivacea* in Nev. (specs.), first in Esmeralda Co., others in Washoe Co.; most records in 1954.

1958. Notes on the red crossbill in Nevada. Condor 60:136-138. Specimens from many localities; allotted to *Loxia curvirostra grinnelli* or *L. c. benti*, both races perhaps intergrading with *L. c. bendirei*.

1963. Biosystematics of sibling species of flycatcher in the *Empidonax hammondii-oberholseri-wrightii* complex. Univ. Calif. Publ. Zool. 66:79-238. Specimens from Nev. listed; range maps.

1965. The breeding avifaunas of the Sheep and Spring Ranges in southern Nevada. Condor 67:93-124. Results of work in Clark Co. in 1963; most important records include: *Meleagris gallopavo*—dates of introduction given; *Columba fasciata*—second record for state (spec.), breeding in Spring Range, assignment to *C. f. monilis* tentatives; *Otus flammeolus flammeolus*—first record for southern Nev. (spec.), breeding; *Glaucidium gnoma californicum*—only verifiable record in Nev. away from Carson Range (spec.); *Caprimulgus vociferus arizonae*—first record for Nev. (spec), possibly breeding; *Sphyrapicus varius*—intergrading of races *S. v. nuchalis* and *S. v. daggetti; Sphyrapicus thyroideus nataliae*—summer resident, breeding; *Empidonax difficilis*—race *E. d. hellmayri* breeding; *Sitta canadensis*—apparently breeding; *Sialia mexicana bairdi*—range extension; *Helmitheros vermivorus*—first record for Nev. (spec.); *Parula americana*—first record for Nev. (spec.); *Dendroica graciae graciae*—first record for Nev. (specs), breeding; *Geothlypis trichas campicola*—second record for state (spec); *Setophaga picta picta*—first record for Nev. (spec.), perhaps breeding or pioneer colony; *Piranga flava hepatica*—first record for Nev. (spec.).

Johnson, Ned K., and Richard C. Banks
1959. Pine grosbeak and Lawrence goldfinch in Nevada. Condor 61:303. *Pinicola enucleator*—first record for state (spec.), race *P. e. californica*, Washoe Co.; *Spinus lawrencei*—first record for state (spec.), Clark Co.; both 1958.

Johnson, Ned K., and Frank Richardson
1952. Supplementary bird records for Nevada. Condor 54:358-359. *Mareca penelope*—Correction to Linsdale, 1951, seen at Reno in 1944, no spec. in 1948; *Buteo swainsoni*—range extension; *Erolia bairdii*—second record (spec.) since 1872; *Zenaida asiatica*—second record for state (sight), Nye Co.; *Asio flammeus*—nest; *Stellula calliope; Auriparus flaviceps*—range extension, first breeding outside Colorado River drainage; *Regulus satrapa; Sturnus vulgaris; Mniotilta varia*—second record for Nev. (sight); *Icterus cucullatus*—second record for state (spec.) probably breeding, Nye Co.; *Molothrus ater*—race *M. a. obscurus* breeding, Nye Co.

Johnson, Ned K., and Ward C. Russell
1962. Distributional data on certain owls in the western Great Basin. Condor 64:513-514. *Otus flammeolus flammeolus*—second record for state (spec.), Washoe Co.

Lanyon, Wesley E.
1961. Specific limits and distribution of ash-throated and Nutting flycatchers. Condor 63:421-449. Maps show Nev. specimens of *Myiarchus cinerascens cinerascens*.

Linsdale, Jean M.
1951. A list of the birds of Nevada. Condor 53:228-249. The starting point for this list; and up-dated condensation of his 1936 work, "The Birds of Nevada," Pacific Coast Avifauna no. 23.

Long, Pauline, and Florence E. Poyser
1965. A record of the groove-billed ani in southern Nevada. First record (sight) of *Crotophaga sulcirostris*, Clark Co., Dec., 1964.

MacDonald, Duncan, and Robert A. Jantzen
1967. Management of Merriam's turkey. pp. 493-534 *in* The Wild Turkey and its Management, Oliver H. Hewitt, ed. The Wildlife Society, Washington, D. C. Information on introduction of *Meleagris gallopavo merriami* in Nev.

Manville, Richard H.
1963. Altitude record for mallard. Wilson Bull. 75:92. 21,000 feet, between Battle Mountain and Elko.

Marshall, David B., and J. R. Alcorn
1952. Additional Nevada bird records. Condor 54:320-321. *Chen caerulescens*—first record for Nev. (mounted display spec.), Churchill Co.; *Chen rossii*—first record for Nev. (spec.), Church-

ill Co.; *Aythya valisineria*—breeds, Elko Co.; *Clangula hyemalis* —first record for Nev. (mounted trophy specs.), Churchill Co.; *Perdix perdix*—not listed by Linsdale, 1951, well established in northern part of state; *Alectoris graeca; Charadrius alexandrinus* —breeding, Churchill Co.; *Catoptrophorus semipalmatus inornatus*—first evidence of breeding, young seen, Douglas Co.; *Sturnus vulgaris*.

Marshall, David B., and LeRoy W. Giles
1953. Recent observations on birds of Anaho Island, Pyramid Lake, Nevada. Condor 55:105-116. *Pelecanus erythrorhynchos; Phalacrocorax auritus; Ardea herodias; Branta canadensis; Anas platyrhynchos; Larus californicus; Mergus merganser; Hydroprogne caspia*—third nesting record for Nev.; observations in 1950 and 1951.

Marshall, Joe T., Jr.
1967. Parallel variation in North and Middle American screech-owls. Monog. Western Foundation of Vertebrate Zoology no. 1. 72 pp. Nev. populations of *Otus asio* in race *aikeni*.

Miller, Alden H.
1955. The breeding range of the black rosy finch. Condor 57: 306-307. *Leucosticte atrata* breeding in Jarbidge Mountains, Elko Co., a range extension.

Miller, Alden H., and Ward C. Russell
1956. Distributional data on the birds of the White Mountains of California and Nevada. Condor 58:75-77. *Dendragapus fuliginosus sierrae; Aegolius acadicus acadicus*—breeding; *Sitta canadensis*—summer resident; *Regulus satrapa olivaceus*—breeding; *Loxia curvirostra grinnelli*—family groups seen; field work in 1954.

Munyer, Edward A.
1965. Inland wanderings of the ancient murrelet. Wilson Bull. 77:235-242. Occurrence of first Nev. record (cf. Gullion, 1956) related to weather.

Norris, Robert A.
1958. Comparative biosystematics and life history of the nuthatches *Sitta pygmaea* and *Sitta pusilla*. Univ. Calif. Publ. Zool. 56:119-300. Nevada populations considered; *S. pygmaea melanotis* in northwest part of state, *S. p. canescens* in south.

Phillips, Allan, Joe Marshall, and Gale Monson
1964. The Birds of Arizona. Univ. of Arizona Press, Tucson. 212 pp. Some references to adjacent parts of Nev.

Pitelka, Frank A.
1951. Speciation and ecologic distribution in American jays of the genus *Aphelocoma*. Univ. Calif. Publ. Zool. 50:195-464. Nev. specimens and populations considered; race *A. coerulescens nevadae* in state.

Porter, Richard D.
1955. The Hungarian partridge in Utah. Jour. Wildl. Mgt. 19:93-109. Some mention of Nev.

Proceedings of the Annual Conferences of the Western Association of State Game and Fish Commissioners.
These mimeographed reports contain papers by persons from Nev. which are concerned mainly with management of game species.

Pulich, Warren M.
1952. The Arizona crested flycatcher in Nevada. Condor 54: 169-170. First records (spec.) of *Myiarchus tyrannulus magister* in state, Clark Co., probably breeding.

Pulich, Warren M., and Gordon W. Gullion
1953. Black-and-white warbler, dickcissel, and tree sparrow in Nevada. Condor 55:215. *Mniotilta varia*—spec. records; *Spiza americana*—first records (sight, one banded), Clark Co.; *Spizella arborea*—Clark Co. record.

Pulish, Warren M., and Allan R. Phillips
1951. Autumn bird notes from the Charleston Mountains, Nevada. Condor 53:205-206. *Colaptes auratus borealis; Colaptes collaris; Sitta carolinensis; Sitta pygmaea; Certhia familiaris; Regulus satrapa*—races *R. s. amoenus* and *R. s. apache*, southern record of species in state (specs.); *Regulus calendula; Carpodacus cassinii; Spinus pinus; Junco; Zonotrichia.*

1953. A possible desert flight line of the American redstart. Condor 55:99-100. Includes records for Clark Co.

Richards, Gerald
1962. Wintering habits of some birds at the Nevada atomic test site. Great Basin Nat. 22:30-31. Notes on *Eremophila alpestris, Carpodacus mexicanus, Amphispiza belli, Sturnus vulgaris, Falso mexicanus, Falco sparverius*, and *Buteo lagopus;* Nye Co., winter 1960-61.

Richards, Gerald L.
1965. Prairie falcon imitates flight pattern of the loggerhead Shrike. Great Basin Nat. 25:48. Dec., 1962, Nye Co.

Richardson, Frank
1952. A second record of the indigo bunting in Nevada. Condor 54:63. *Passerina cyanea*, Nye Co., June, 1951 (spec.).

Rickard, W. H.
1960. An occurrence of the rose-breasted grosbeak in southern Nevada. Condor 62:140. *Pheucticus ludovicianus*, second record (sight), Clark Co., 1959.

1961. Notes on bird nests found in a desert shrub community following nuclear detonations. Condor 63:265-266. *Buteo swainsoni; Tyrannus verticalis; Sayornis saya; Eremophila alpestris; Mimus polyglottos; Carpodacus mexicanus; Amphispiza bilineata; Spizella breweri;* Nye Co., 1958-1960.

Rogers, Glenn E.
1963. Blue grouse census and harvest in the United States and Canada. Jour. Wildl. Mgt. 27:579-585. Some data for Nevada.

Ryser, Fred A.
1963. Prothonotary warbler and yellow-shafted flicker in Nevada. Condor 65:334. *Protonotaria citrea*—first record for Nev. (spec.), south of Reno; *Colaptes auratus luteus*—first record of this race in Nev. (spec.).

Schorger, A. W.
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BIRD RECORDS FOR CLARK COUNTY NEVADA

George T. Austin and W. Glen Bradley[1]

The following sight records by Austin include one species not previously reported from Nevada and seven not reported from Clark County. The specimen of Virginia Rail is deposited in the Biology Museum, Nevada Southern University at Las Vegas.

Phoenicopterus ruber. American Flamingo.

On 20 October 1962 on the shore of Lake Mead near Overton, an individual was observed for 30 minutes. Although in all probability it was an escaped bird, its color was bright.

Buteo lagopus. Rough-legged Hawk.

A bird of light phase observed near Overton on 22 December 1962 appears to be the first record for Clark County.

Rallus limicola. Virginia Rail.

A specimen (B-235) was collected by Bradley at Henderson Slough on 27 February 1964. Observations were made at the same locality on 5 March 1964 and 7 April 1965 and at Tule Springs on 30 March 1964. These are the first records for Clark County.

Erolia melanotos. Pectoral Sandpiper.

There is one record for the Nevada Test Site, Nye County, Nevada (Hayward, et. al., 1963:9). Two observed at Overton Beach on 4 October 1964 constitute the first record for Clark County and the second for Nevada.

Larus argentatus. Herring Gull.

Individuals observed at Overton Beach on 22 December 1962 and 1 February 1964 are the first records for Clark County.

Asio flammeus. Short-eared Owl.

An individual sighted at Henderson Slough on 5 March 1964 is the first record for Clark County.

Trogolodytes trogolodytes. Winter Wren.

Individuals observed on 22 and 30 December 1963 at Gilcrease Ranch, northwest of Las Vegas are the first records for Clark County.

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Lanius excubiter. Northern Shrike.

An adult observed at close range (breast barring very evident) near Tule Springs on 29 September 1962 is the first record for Clark County.

Richmondena cardinalis. Cardinal.

A male was observed in a mesquite thicket along the road to Red Rock Canyon in the Spring Range on 4 February 1962. This is the first record for Nevada.

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SPAWNING ECOLOGY OF THE WHITE BASS *ROCCUS CHRYSOPS* (RAFINESQUE) IN UTAH LAKE, UTAH[1]

Frederic Vincent[2]

Utah Lake, located in Utah County, north central Utah, is one of the most important natural fishing lakes in the state. The species of prime importance to the fisheries of the lake are the Channel Catfish, *Ictalurus punctatus*, (Rafinesque) and the Walleye, *Stizostedion vitreum vitreum* (Mitchill). Of increasing importance to the sport fisheries is the White Bass, *Roccus chrysops*, (Rafinesque). This species was introduced into Utah Lake in the summer of 1956 when 209 fish were transplanted from Colorado. No subsequent plantings have been made. Since its introduction, the White Bass has shown a phenomenal increase in numbers.

This large lake lies in a north-south axis and is slightly over 20 miles long. The extreme east-west axis is slightly over six miles wide. Surface area at maximum capacity is 95,900 acres (Lawler, 1960). Average depth in June 1966 was eight feet (Figure 1). The lake is unique in that it lies in the center of an arid region (annual rainfall of approximately 15 inches) and receives water from clear

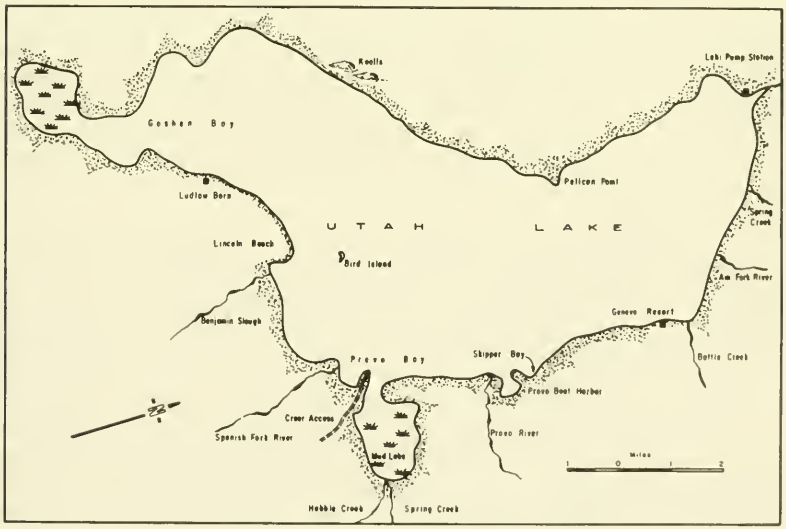

Fig. 1. Outline map of Utah Lake showing major tributaries and points of reference.

1. This study was made possible through the financial support of the Utah State Department of Fish and Game. I wish to express my gratitude to Donald Andriano, Chief of Fisheries, for giving support to this work.

2. Fisheries Biologist, Utah State Department of Fish and Game. Presently with the U. S. Fish and Wildlife Service, Laconia, New Hampshire.

mountain streams, yet it is always turbid. The shallowness of the lake basin and the persistent winds stirring the mud and silt of the lake into the water are responsible for the turbidness. Summer turbidity measured after normal winds during August 1959 reached a maximum of 45 ppm SiO_2 equivalents (Arnold, 1960).

Because of the irrigation demands of Salt Lake Valley, the lake is constantly fluctuating. Surface water temperatures never exceeded 72°F. during the period of this study, although Lawler (1960) reported 82°F. readings in 1959.

The study of the spawning ecology of the White Bass in Utah Lake was initiated in 1964 and completed in 1966. The principal objectives of this study were: (1) to locate the spawning grounds and (2) describe the activities of the Bass prior to, during, and after spawning.

Publications concerning various phases of life history and homing of the White Bass are numerous. Hasler and Henderson (1963), Lewis (1950), McNaught and Hasler (1961), Sigler (1947), (1949a, 1949b), and Horrall (1956 and 1961) have contributed greatly to the overall knowledge of this species. Riggs' study (1955) on the reproduction of the White Bass in Shafer Lake, Indiana, is one of the few comprehensive works regarding spawning of this species.

History

White Bass were introduced into Utah Lake in the summer of 1956 from fish obtained from the Colorado Game, Fish and Parks Department. Ten years after its introduction, the species had spread throughout Utah Lake, up into its tributaries and north along the Jordan River (including its tributaries) to Salt Lake City. The range has been extended within the state recently with a limited introduction into Delta Reservoir near Delta, and Willard Bay Reservoir near Ogden, Utah.

The natural range of the White Bass was originally Minnesota, Wisconsin, Michigan and the Great Lakes, especially Lake Erie (Hubbs and Lagler, 1947). Stocking throughout the country has extended the range of the White Bass south along the Mississippi and Ohio River drainages to the Gulf States of Alabama, Mississippi and Florida, and southwest into Texas, Oklahoma, New Mexico and Arizona. The densest populations can be found in Texas and Oklahoma, notably Lake Texoma (Sigler and Miller, 1963). Hubbs *et al.* (1947) reported that the range of the White Bass extended east through New York via the St. Lawrence River to the city of Quebec. A recent introduction into Lahontan Reservoir, Nevada, from bass taken from Utah Lake appears to have been successful. This is believed to be the most westerly successful introduction of this species. In January 1967, 150 White Bass from Utah Lake were flown to California Department of Fish and Game personnel for introduction into Nacimiento Reservoir north of Paso Robles. The success of this stocking effort has yet to be determined.

Study Area

From the beginning of this study, it was felt that the White Bass in Utah Lake would likely seek out firm bottom types for spawning. As only five percent of Utah Lake's basin has a firm bottom composition, chances were that the spawning grounds could be located in the first summer's study. However, all possibilities had to be carefully checked.

Sampling began in mid-June 1965 near the southern portion of Goshen Bay. This was somewhat later than anticipated because of equipment problems. Four gill nets, two floating types used for sampling to a depth of six feet and two divers for bottom and intermediate zone samples with identical mesh sizes, were fished at the same time but in different locations. Net specifications were as follows: 125 feet long, six feet deep with stretch mesh sizes from ¾ inch to 1¾ inches. Each net consisted of five sections, 25 feet per section.

The four gill nets were deployed so that the combined sets could cover as much area as possible. The nets were moved after a set had been pulled and reset in a new location, usually one to three miles from the previous set. There were times when all four nets were set in one area; however, the nets were usually fished in pairs in different locations.

During mid-June and July of 1965, neither the unisexual schools of females usually located near spawning grounds nor the unisexual schools of mature males found on the spawning grounds were located. Nets placed in the only major inflowing water, Provo River, failed to sample any bass during the study period, thus eliminating all areas as to possible spawning sites except the suspected hard bottom areas of Lincoln Beach and Bird Island. Of the 111 males collected in 1965, 88 or 79.3 percent were subadults[3]; and of the 49 females collected, 44 or 89.9 percent were subadults.

Numerous gill net sets were made along Lincoln Beach and off Bird Island in order to determine the range of spawning activity during the spring and summer of 1966. No spawning activity could be found off Bird Island; however, spawning activity was discovered off Lincoln Beach, which was then divided into three sampling areas of 3,000 feet in order to determine the range of utilization for spawning (Figure 2).

Sample area I consisted of the west boat basin along the south shore past the rocky out-croppings (see Figure 2). Two small warm water springs were located in this area in three feet of water. Temperatures in each spring were a constant 81° F. during the course of the study. The lake bottom bordering the adjacent section II consisted mostly of ledge rock and rubble and extends into the lake no more than 200 feet. Toward the west boundaries of section I the bottom material changes to mud and organic silt.

The lake basin sample area II is composed entirely of ledge rock and rubble. This rock formation extended out into the lake a dis-

3. A subadult is defined as a Bass too young to spawn or one that will spawn the following year.

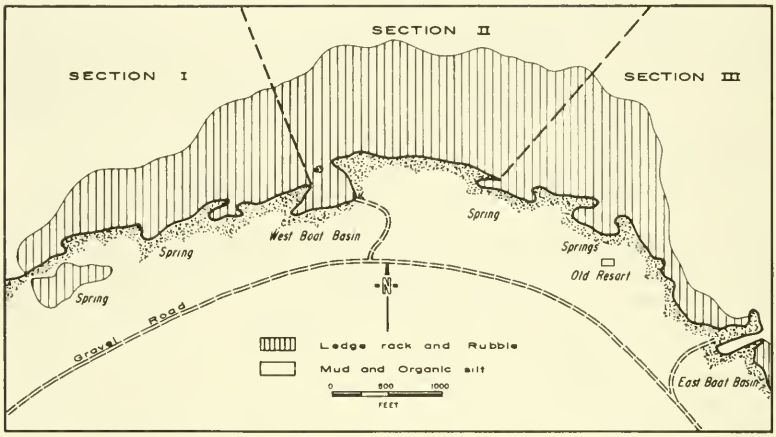

Fig. 2. Lake bottom types off Lincoln Beach, from photograph and ground observations, September 7, 1966.

tance of 750 feet. Distances from shore would markedly vary with surface fluctuations in this shallow littoral zone. The majority of spawning occurred in this area.

Section III lies to the west of the large bay into which Benjamin Slough empties. The only areas of ledge rock occurred adjacent to section II. The lake basin, 10 feet off shore and south to the east boat basin, was composed of mud and organic silt. Two large warm water springs occur in this area. Water temperatures in these springs varied from 71° to 75°F. throughout the length of the study.

Spawning Migrations

Unisexual Schooling Prior to Spawning

It is generally agreed by various workers that White Bass gather together in large unisexual schools prior to spawning. Riggs (1955) noted that unisexual schooling was first apparent in Buckey Lake, Ohio, when water temperatures reached 58°F.

In Utah Lake, signs of unisexual schooling first appeared when water temperatures reached 52°F. in mid-April. Small numbers of mature males were taken off Lincoln Beach during this period, but it was not until water temperatures reached 56°F. in late April that numerous homogenous groups of mature male bass appeared in gill net sets.

At no time during the study were large unisexual schools of mature female White Bass located in Utah Lake. Riggs (1955) and Sigler (1949a) noted that mature females were captured from deeper water, often just off shoals or tributary mouths. Extensive gill nettings in shoal areas near Lincoln Beach failed to locate these female

unisexual schools. Gravid female bass were taken in nets on the spawning grounds prior to, during, and after spawning, but never in large numbers. However, a limited number of gravid females were sampled in the large area between Creer Access and Bird Island leading the author to believe that this area is the schooling location for the gravid females prior to movement to the spawning grounds off Lincoln Beach, a distance of three miles.

It was also of interest to note that no immature bass of either sex were ever taken on the spawning site during or just prior to spawning.

The first large number of mature male bass to be captured off Lincoln Beach in net sets appeared the first week of April. Their number did not seem to increase significantly after this earlier observation, although sets made one month later produced larger males than did the earlier sets. On May 6, 1966, when water temperatures had reached 63°F., the first gravid females appeared over the spawning area. From all indications, it appears that the gravid females migrate to shoal areas in small numbers, spawn, and then return to the area off Creer Access, never remaining over the shoal longer than is necessary to spawn.

Reproduction

Spawning Site

The only spawning activities observed during the course of the study were in the area off Lincoln Beach. There was no attempt to spawn near the Bird Island shoals, although the bottom composition is identical with that off Lincoln Beach (rubble interspersed with ledge rock and boulders). There is no evidence to explain why the bass selected Lincoln Beach and not Bird Island or why they were not found utilizing both locations, as they are only separated by 1.5 miles of water.

Spawning activities around Lincoln Beach were restricted to an area beginning near the East Boat Basin and extending west to about 0.25 mile east of the boat basin near the old resort. Spawning activity extended out from shore a distance of 15 feet over the ledge rock but never beyond this bottom type into the mud (Figure 3). White Bass were taken by gill nets in stands of Tamarix, *Tamarix pentandra*, that has been inundated by high water. However, the actual spawning took place in open water, 10 to 15 feet off shore.

Eggs were taken off the ledge rock in 60 inches of water. This type of rock is quite porous and affords good holdfasts for the demersal and adhesive eggs.

Water Temperatures

The first observed spawning activity on Utah Lake occurred on May 6, 1966, when surface temperatures off Lincoln Beach were 63°F. The females continued to spawn through the middle of June when surface temperatures reached a maximum of 69°F. Males

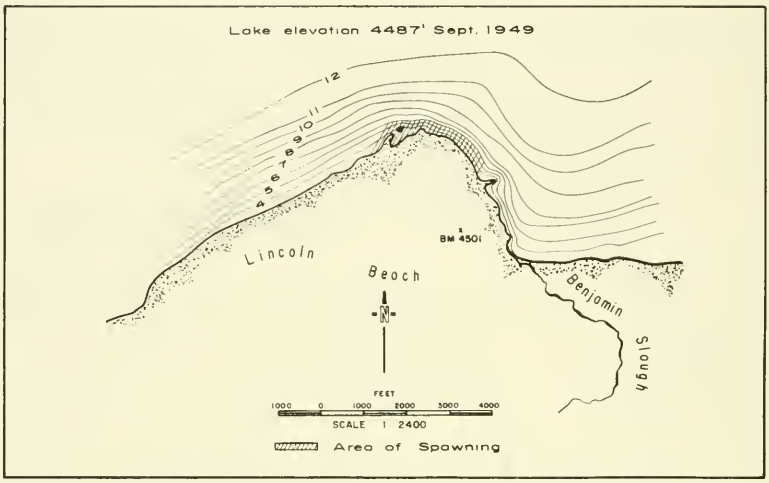

Fig. 3. Map of Lincoln Beach area, showing lake contours in feet, and principal areas of spawning (shaded).

moved over the spawning site during late March and early April when surface temperatures ranged between 48° to 52°F. Utah Lake water was found to be homothermic during the spring and early summer months.

Duration of Spawning

The first ripe, partially spawned-out female was taken in a gill net on June 10, 1966. It was shortly after this (on June 15) that spawned-out females were captured. Spawning activity lasted from 10 to 15 days on Utah Lake, although other investigations have found that the spawning periods lasts from five to ten days.

Behavior During Spawning

Owing to the extreme turbidity of the water in Utah Lake, actual spawning activities were never observed. Ripe males could be taken in nets throughout the day or night over the ledge rock, but most activity occurred in the late evening and early morning. Gravid females were never taken prior to 0400 and never after 0900 hours. Spawning bass generally come within six to eight inches of the surface; this is then followed by a confused scramble with many fish milling in wild gyrations about a central fish. Immediately after this there appears a cloudiness, apparently caused by emitted sperm. The fish then return quickly to their original locations.

By the first part of July, bisexual schools of bass could be found feeding in the Mud Bay area of the lake, indicating that the unisexual populations soon unite to form into large and fairly rapidly moving feeding schools. By Mid-August, adult females as well as males were found together throughout the lake.

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REMARKS ON THE TYPE SPECIMEN OF *BUFO ALVARIUS* GIRARD

M. J. Fouquette, Jr.[1]

The Colorado River Toad, *Bufo alvarius*, occurs in lowland areas of southern Arizona and adjacent corners of southeastern California, southwestern New Mexico and northeastern Baja California, through most of Sonora, and into northern Nayarit, Mexico. It is one of the largest anurans in the U. S., sometimes exceeding seven inches, snout to vent. Kellogg (1932) reviewed the taxonomy of the species and was not able to satisfactorily define the holotype or type locality.

The toad was originally described, in a brief paragraph, by Girard (1859), in Baird's report of the survey of the U. S.-Mexican boundary. The description was terminated with, "Valley of Gila and Colorado. A. Schott." No types were designated, nor were any specific specimens cited. Cope (1889) later reported that the ". . . species is as yet known from a single specimen . . . in the National Museum." He listed the specimen, "No. 2572 . . . Fort Yuma, Cal.; A. Schott." This specimen would then seem to be the holotype. However, Kellogg (1932) pointed out that USNM No. 2572 was actually collected by Maj. G. H. Thomas, and that the entry for No. 2571 indicated two specimens of *Bufo alvarius* from " Sierra de la Union y Charcos de la Nariz," collected by A. Schott. He further noted that the drawings of *Bufo alvarius* which were reproduced in Baird's report had a notation in Baird's handwriting, "Sierra de la Union," which would seem to indicate one of the specimens No. 2571. Kellogg could not locate either of the specimens cataloged as No. 2571, but he designated all three specimens represented by Nos. 2571-2572 as co-types (in the sense of syntypes). Cochran (1961) listed only one specimen among the types in the National Museum, "Cotype: 2572, Fort Yuma (Imperial County), California. G. H. Thomas, 1855." James A. Peters (pers. comm., April 1968) confirms that the two specimens No. 2571 are still missing, and notes that it is unlikely that they will be found, as every bottle in the USNM collection was handled during the move into the new wing, and the two *Bufo* were not among them.

As Kellogg (1932) pointed out, the locality of the missing Schott specimens (2571) does not agree with the locality given by Girard, whereas the locality of the Thomas specimen (2572 does conform. Cope (1889) apparently was unaware of the 2571 catalog entry, and probably did not consult the catalog, listing Schott as collector by virtue of the information in Girard's (1859) description. Schmidt (1953) restricted the type locality to "Colorado River bottom lands below Yuma, Arizona," with no indication of his basis for this.

Although Girard (1859) did not designate a type specimen, it seems reasonable to assume that the type series consisted of USNM

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Nos. 2571 and 2572, in spite of certain inconsistencies. Kellogg (1932) made this assumption in designating these specimens as cotypes (=syntypes). However, Cope (1889) preceded Kellogg in considering USNM No. 2572 as the holotype, by implication; i.e., he was the first to designate a particular specimen to the nominal species, and the specimen was from what must be assumed to be the type series, and assumed by Cope to be the only specimen. If we accept the series 2571-2572 as syntypes, then Cope (1889), in essence, designated USNM No. 2572 as the lectotype of *Bufo alvarius*, by implication, even though this was not his intent. Thus, I suggest that U. S. National Museum No. 2572 be recognized as the lectotype of *Bufo alvarius* Girard, in accordance with Article 74(a) of the International Code of Zoological Nomenclature (1964). The specimens represented by USNM No. 2571 become paralectotypes should they ever be located (Recommendation 74E). Should one not agree that Cope's work constitutes designation of a lectotype, then by provision of Article 74(a), I so designate USNM No. 2572, from among the syntypes designated by Kellogg (1932).

USNM No. 2572 is from old Fort Yuma, California, across the Colorado River from Yuma, Arizona, near the junction with the Gila River. Thus, the locality given by Girard (1859) seems clearly referable to this specimen. It would seem necessary to reject or modify Schmidt's (1953) restriction of the type locality, and restrict it instead to the locality of No. 2572; i.e., Fort Yuma, Imperial County, California (on the north bank of the Colorado River, opposite its junction with the Gila River).

I have examined USNM No. 2572, and it is a well-preserved, though bleached example of the species. Girard's (1859) type description is very brief and generalized. It says nothing that conflicts with USNM No. 2572. Likewise, the drawing (Plate 41, Fig. 1-6) agrees in all essentials with the specimen at hand. Cope (1889) described this specimen in detail, and provided good drawings of the head and feet. To Cope's description may be added the information that the specimen is female, with pigmented ovarian eggs. Some minor corrections might also be made. Cope described the tympanum as round, although his drawing clearly and correctly indicated that it is actually oval, distinctly higher (10.3 mm) than wide (9.2 mm). The length of the eye fissure is 14.8 mm, so that the greatest diameter is actually less than the three-fourths of the eye fissure length claimed by Cope. In describing the extent of the parotoid gland he noted that the gland reaches a position ". . . nearly on a level with the posterior border of the *membranum tympani*." This should read ". . . the ventral border of the *membranum*. . ." Cope also failed to note the distinctive long, narrow, oval gland occupying most of the upper surface of the forearm.

In re-measuring the specimen, I find that the total length given by Cope is also in error. He gives .165 M (=165 mm), whereas I measure 143 mm, snout to vent. His measurement undoubtedly was 145 mm and somehow this was transposed to 165 in print. My other measurements do not differ significantly from Cope's.

In comparing the type with more recent samples of female *Bufo alvarius* of the same and larger size, from the vicinities of Phoenix, Arizona, and Alamos, Sonora, it is obvious that the lectotype has a relatively much broader head than any of these. If samples from the vicinity of Yuma should show the same difference, this might suggest that perhaps there has been a tendency toward a narrower head in the intervening 100 years.

Thanks are due James A. Peters for the loan of the type-specimen in his care, and for the information on the other specimens as noted.

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FLEAS OF THE NATIONAL REACTOR TESTING STATION[1]

Dorald M. Allred[2]

From June, 1966 to September, 1967, 4050 mammals and 561 birds were examined for ectoparasites at the National Reactor Testing Station in southern Idaho (Table 2; Figs. 1, 2). This paper lists the fleas which were collected. A previous report (Allred, 1968) discussed the area, field activities, study sites, techniques, and ticks collected.

I am indebted to Dr. D Elden Beck for the identification of most of the fleas prior to his untimely death in August, 1967. Dr. William

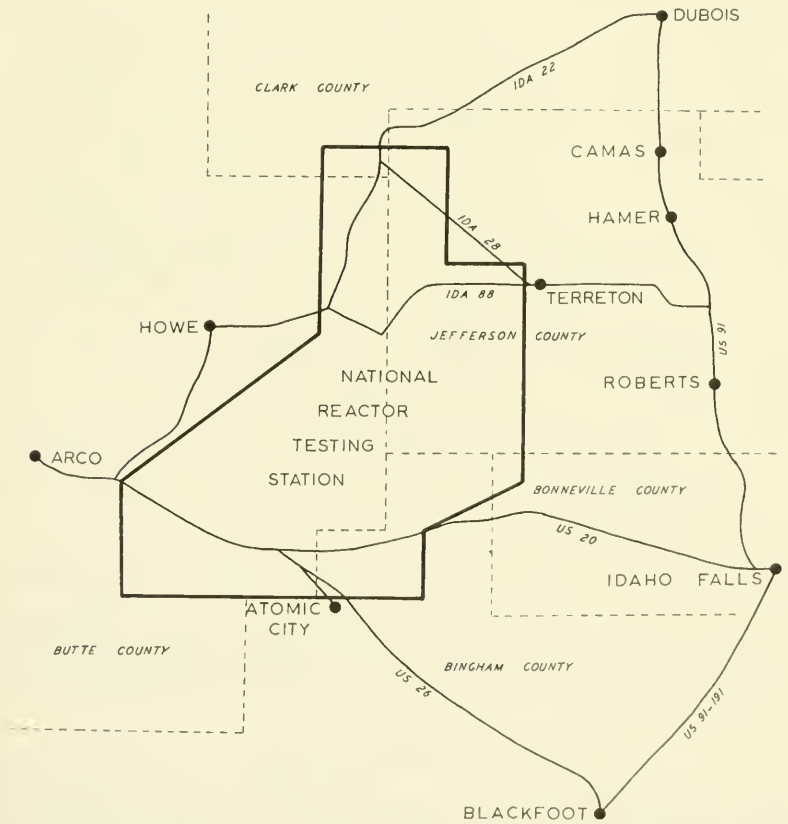

Fig. 1. Geographic position of the National Reactor Testing Station in southeastern Idaho.

1. BYU-AEC report no. C00-1559-2.
2. Department of Zoology and Entomology, Brigham Young University, Provo, Utah.

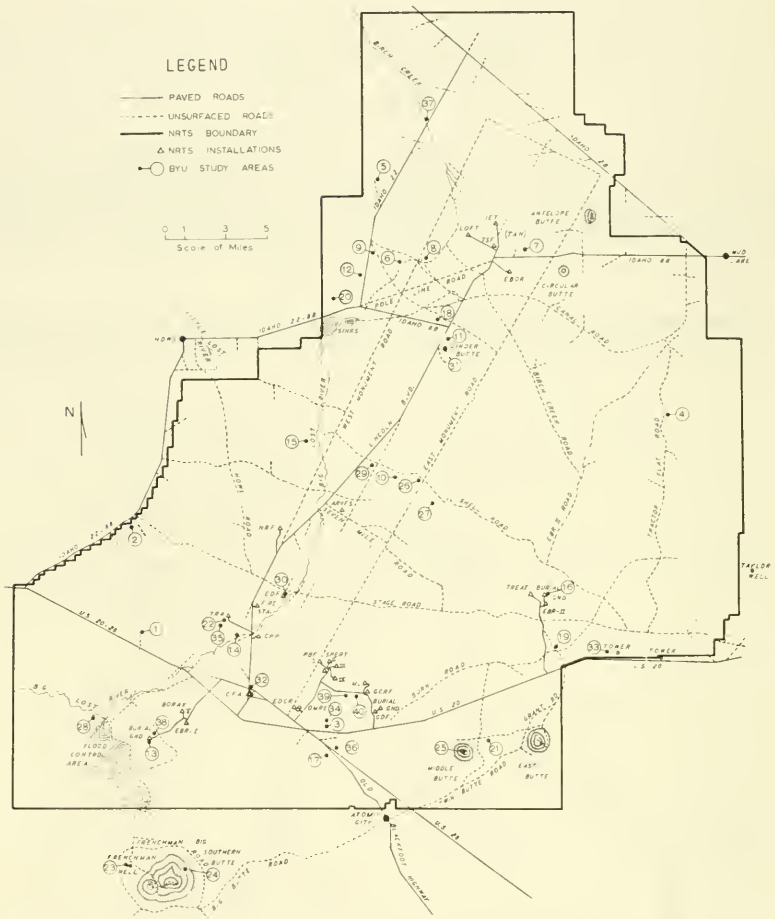

Fig. 2. Major installations, roads, and study areas at the National Reactor Testing Station.

L. Jellison, Hamilton, Montana, identified several hundred additional fleas, and verified some tentative identifications made by Dr. Beck of unusual specimens.

Flea-Host Associations

Data in the list below are arranged as follows: (1) The species of flea collected is given without subspecific relegation. An asterisk preceding the name of the flea indicates that in other studies it has been shown to be of medical importance in the epidemiology of plague (Stark, 1958). After the name of the flea, its general seasonal occurrence (in parentheses) and its geographic distribution at the

station as indicated by our collections are given. (2) Indented under the name of the flea are the hosts from which it was taken at the station. Where more than one host is listed, an asterisk preceding the name of the host indicates that it is the one from which the flea was most commonly taken and/or for which the flea-host index (number of fleas taken divided by the number of hosts infested) was high. After the host's name the number of hosts examined (in parentheses) is listed. This number is given only once for each host—the first time the host's name is listed. The number not in parentheses and immediately in front of the colon is the flea-host index. Behind the colon the numbers of each sex of flea taken during each month are given. Records for June, July, and August are the combined collections for 1966 and 1967; others as indicated represent only one month's data.

Amphipsylla siberica (summer-fall) limited distribution
Microtus montanus (25) 1: ♂ July
**Peromyscus maniculatus* (1866) 2: 2♂ Oct.

Anomiopsyllus amphibolus (winter) limited distribution
Neotoma cinerea (14) 1: ♀ Dec.

Callistopsyllus terinus (spring-summer) limited distribution
Peromyscus maniculatus 2: 2♂ 4♀ Feb., 3♂ 1♀ March, ♂ ♀ July, ♂ 3♀ Aug., ♀ Sept.

**Catallagia decipiens* (year round) limited distribution
Dipodomys ordii (808) 1: ♀ May
Eutamias minimus (398) 1: 2♂ 1♀ March, ♀ June
**Peromyscus maniculatus* 2: ♂ ♀ Jan., 6♂ 12♀ March, 3♂ 2♀ May, 4♂ 5♀ June, 4♂ 5♀ July, 10♂ 6♀ Aug., ♂ ♀ Oct., ♂ Nov.
Junco oreganus (30) 1: ♂ April

Cediopsylla inaequalis (year round) moderate distribution
Canis latrans (6) 5: 2♀ Jan., ♂ 8♀ Feb., ♀ Nov., 2♂ 5♀ Dec.
**Lepus californicus* (125) 4: ♂ 5♀ Jan., 37♂ 40♀ March, 5♂ 2♀ April, ♂ 2♀ May, 2♂ 5♀ June, ♂ 3♀ July, 2♂ 5♀ Aug., 2♂ 3♀ Sept., 3♂ 5♀ Oct., 3♂ 10♀ Nov., 14♂ 16♀ Dec.
Lynx rufus (8) 24: 14♂ 23♀ Jan., 10♂ 15♀ April, 24♂ 69♀ Nov.
Peromyscus maniculatus 4: 8♂ 6♀ Feb., ♂ March, ♂ July
**Sylvilagus idahoensis* (13) 21: 62♂ 109♀ Feb., ♂ 2♀ April, ♀ July, 7♂ 13♀ Nov.
**Sylvilagus nuttallii* (28) 13: 108♂ 42♀ Feb., ♂ March, 5♂ 4♀ May, 13♂ 4♀ June, ♂3♀ July, 4♂ 7♀ Aug., ♂ 5♀ Nov., 11♂ 15♀ Dec.

Epitedia stanfordi (spring) limited distribution
Peromyscus maniculatus 2: 3♂ 3♀ Feb., 3♂ April

**Epitedia wenmanni* (year round) moderate distribution
Dipodomys ordii 1: ♂ Oct.
Neotoma cinerea 1: ♀ Nov.
**Peromyscus maniculatus* 2: 2♂ 1♀ Jan., 3♂ 5♀ Feb., 4♂ 5♀ March, 2♂ April, ♂ May, ♀ June, ♀ Aug., ♂ Sept., 3♂ 4♀ Oct., 4♂ 3♀ Nov., 4♀ Dec.

**Foxella ignota* (spring-summer-fall) moderate distribution
Dipodomys ordii 1: ♀ June
Mustela frenata (4) 2: 2♂ 2♀ July
**Onychomys leucogaster* (63) 8: 4♂ 5♀ March, ♂ April, 14♂ 18♀ June, 18♂ 26♀ July, 6♂ 9♀ Aug., 41♂ 57♀ Sept., 3♀ Oct.
Peromyscus maniculatus 1: 2♂ March, ♂ 2♀ July, ♀ Aug., 2♂ Sept., ♀ Nov., ♂ Dec.
**Thomomys talpoides* (8) 8: 2♂ 7♀ March, 19♂ 14♀ June, ♀ Sept., 5♂ 9♀ Oct., 2♂ 7♀ Nov.

Hystrichopsylla occidentalis (summer-fall) limited distribution
Peromyscus maniculatus 1: ♀ May, ♂ ♀ Nov.

Malaraeus bitterrootensis (summer) limited distribution
Neotoma cinerea 2: ♂ 3♀ Aug., ♂ 2♀ Sept.

Malaraeus euphorbi (fall-winter-spring) moderate distribution
Microtus montanus 3: 3♀ Aug.
**Peromyscus maniculatus* 3: 2♂ 1♀ Feb., 4♂ 5♀ March, ♂ May, 2♂ 2♀ Aug., ♂ ♀ Sept., 7♂ 11♀ Oct., 3♂ 2♀ Nov., ♂ Dec.

**Malaraeus telchinum* (winter-spring-summer) moderate distribution
Microtus montanus 1: ♂ Aug.
Neotoma cinerea 1: ♀ Aug.
Onychomys leucogaster 1: ♀ July
**Peromyscus maniculatus* 2: 4♂ Jan., 5♂ 1♀ Feb., 9♂ 8♀ March, 2♂ May, 24♂ 17♀ June, 15♂ 8♀ July, 3♂ Aug., ♂ Sept., 2♂ Dec.
Perognathus parvus (474) 1: ♂ June

**Megabothris abantis* (summer) limited distribution
Host unknown: ♀ June, 2♂ July

Megabothris obscurus (fall) limited distribution
Host unknown: ♂ Nov.

**Megarthroglossus divisus* (summer) limited distribution
Neotoma cinerea 1: ♀ Aug.

Meringis hubbardi (spring-summer-fall) moderate distribution
Dipodomys ordii 2: ♂ ♀ May, 6♂ 3♀ June, 4♂ ♀ July, 3♂ 2♀ Aug., ♂ Sept., ♀ Nov.
Eutamias minimus 1: ♂ Oct.
Mustela frenata 1: ♂ July
**Onychomys leucogaster* 4: ♂ March, 3♂ June, 13♂ 8♀ July, 22♂ 7♀ Aug.
**Perognathus parvus* 3: 36♀ 58♀ May, 11♂ June, 28♂ 18♀ July, 17♂ 4♀ Aug., 7♂ 3♀ Oct.
Peromyscus maniculatus 2: 6♀ March, ♂ April, 3♂ ♀ May, 19♂ 10♀ July, 18♂ 10♀ Aug., 2♂ ♀ Oct.
Reithrodontomys megalotis (39) 1: ♂ ♀ Aug.
Sorex merriami (9) 1: ♂ Aug.

Meringis parkeri (year round) extensive distribution
**Dipodomys ordii* 5: 29♂ 38♀ March, 23♂ 36♀ April, 20♂ 31♀ May, 148♂ 175♀ June, 186♂ 201♀ July, 298♂ 397♀ Aug., 62♂ 97♀ Sept., 87♂ 88♀ Oct., 14♂ 26♀ Nov.
Eutamias minimus 2: ♂ March, ♀ June, ♀ July, ♂ 3♀ Aug., 8♂ 5♀ Oct.
Lepus californicus 1: ♀ Dec.
Microtus montanus 1: ♀ Oct., ♀ Nov.
Mustela frenata 1: ♂ July
Neotoma cinerea 1: ♀ Aug.
**Onychomys leucogaster* 6: 5♂ 3♀ March, ♂ April, 17♂ 25♀ June, 13♂ 22♀ July, 18♂ 22♀ Aug., 3♂ 3♀ Sept., 29♂ 38♀ Oct., 3♂ 5♀ Dec.
Perognathus parvus 2: 4♂ 13♀ May, 17♀ June, 2♂ 17♀ July, ♂ 12♀ Aug., ♂ ♀ Oct.
Peromyscus maniculatus 2: ♀ Jan., ♂ 3♀ March, 2♂ 2♀ April, ♀ May, 7♂ 12♀ June, 15♂ 38♀ July, 14♂ 38♀ Aug., 4♂ 8♀ Sept., 12♂ 17♀ Oct., ♂ 2♀ Nov.
Reithrodontomys megalotis 1: ♂ Oct.
Sorex merriami 3: ♂ 5♀ Aug.
Spermophilus townsendii (60) 1: ♂ March, 2♀ June, ♀ July

**Monopsyllus eumolpi* (year round) moderate distribution
Dipodomys ordii 1: ♀ June, ♀ Sept., ♂ Oct.
**Eutamias minimus* 5: 74♂ 87♀ March, 2♂ ♀ May, 45♂ 88♀ June, 40♂ 59♀ July, 53♂ 85♀ Aug., 4♂ 3♀ Sept., 11♂ 39♀ Oct., ♂ ♀ Nov.
Perognathus parvus 1: ♀ July, ♀ Aug.

Peromyscus maniculatus 2: ♂ 2♀ Jan., 2♂ March, 2♀ June, ♂ 6♀ July, 3♂ 4♀ Aug., 2♂ ♀ Oct.
Spermophilus townsendii 1: ♂ June

**Monopsyllus exilis* (spring-summer-fall) limited distribution
Dipodomys ordii 1: ♂ May, ♂ June.
**Onychomys leucogaster* 6: 3♂ 3♀ March, 2♀ April, 29♀ 55♀ June, 18♂ 16♀ July, 11♂ 14♀ Aug., 2♂ 8♀ Sept., 6♂ 12♀ Oct.
Peromyscus maniculatus 1: ♀ Jan., ♀ Sept.

**Monopsyllus wagneri* (year round) extensive distribution
Dipodomys ordii 1: ♂ Feb., ♀ March, 3♂ 10♀ June, 3♂ 4♀ July, 2♀ Aug., 2♂ Sept., ♂ 2♀ Oct.
Eutamias minimus 3: ♂ 4♀ March, 2♂ 2♀ June, ♂ 9♀ July, ♂ ♀ Aug.
Lepus californicus 1: ♀ June
Marmota flaviventris (6) 1: ♂ June
Microtus montanus 1: ♂ June, 2♀ July
Mus musculus (1) 1: 2♂ ♀ June
Neotoma cinerea 1: ♂ June, ♂ ♀ Sept.
**Onychomys leucogaster* 3: ♂ April, 9♂ 4♀ June, 7♂ 2♀ July, 3♂ 3♀ Aug., 4♂ ♀ Sept., 3♂ 5♀ Oct.
Perognathus parvus 2: 2♀ June, 4♂ 4♀ July, ♂ ♀ Aug.
**Peromyscus maniculatus* 5: 5♂ 13♀ Jan., 11♂ 5♀ Feb., 208♂ 199♀ March, 53♂ 44♀ April, 47♂ 62♀ May, 926♂ 1190♀ June, 688♂ 901♀ July, 313♂ 374♀ Aug., 71♂ 62♀ Sept., 55♂ 78♀ Oct., 19♂ 34♀ Nov., 4♂ 6♀ Dec.
Reithrodontomys megalotis 2: ♂ June, ♀ July, 4♂ 3♀ Aug., 2♀ Oct.
Spermophilus townsendii 3: ♀ April, 4♂ 5♀ June
Sylvilagus idahoensis 1: ♂ Feb.
Sylvilagus nuttallii 1: ♂ ♀ Aug.

Odontopsyllus dentatus (spring-summer) limited distribution
**Lepus californicus* 2: 4♂ 6♀ March, 6♂ April, ♀ July
Lynx rufus 6: 2♂ Jan., 11♂ 4♀ April

**Opisocrostis labis* (summer) limited distribution
Dipodomys ordii 1: ♂ May, ♂ July
Eutamias minimus 1: 2♀ July, ♀ Aug.
Onychomys leucogaster 1: ♂ July
Peromyscus maniculatus 1: ♂ Dec.
**Spermophilus townsendii* 3: ♂ April, 6♂ 5♀ June, 2♀ July

**Opisocrostis tuberculatus* (spring) limited distribution
Spermophilus townsendii 4: 4♂ 5♀ April

**Opisodasys keeni* (summer-fall) limited distribution
Peromyscus maniculatus 2: 4♂ 3♀ March, 7♀ May, 2♂ June, 2♂ 2♀ July, ♀ Oct., ♂ Nov.

**Orchopeas leucopus* (summer) limited distribution
Eutamias minimus 1: ♀ July

**Orchopeas sexdentatus* (summer-fall-winter) moderate distribution
Eutamias minimus 1: ♂ Sept.
Lynx rufus 1: ♂ ♀ Nov.
**Neotoma cinerea* 13: 10♂ 27♀ June, 3♂ 3♀ July, 19♂ 36♀ Aug., 36♂ 38♀ Sept., 7♂ 8♀ Nov., ♂ Dec.
Peromyscus maniculatus 7: ♀ Jan., 2♀ March, ♀ June, 10♂ 15♀ Aug.

**Peromyscopsylla hesperomys* (summer) limited distribution
Neotoma cinerea 1: ♂ Aug.
**Peromyscus maniculatus* 2: ♀ July, 4♂ 3♀ Aug., ♀ Sept.

Phalacropsylla allos (summer) limited distribution
Neotoma cinerea 1: ♂ ♀ Aug.
**Onychomys leucogaster* 2: 2♀ Sept.

Phalacropsylla paradisea (spring) limited distribution
Peromyscus maniculatus 1: ♂ March

**Pulex irritans* (summer-winter) extensive distribution (because of host relationships)
**Canis latrans* 3: 2♂ 6♀ Jan., ♂ Aug., ♂ 2♀ Nov., ♀ Dec.
Taxidea taxus (5) 1: ♀ April
**Vulpes fulva* (+) 9: 15♂ 13♀ July

Rectofrontia fraterna (fall) limited distribution
**Onychomys leucogaster* 15: 13♂ 17♀ Sept.
Peromyscus maniculatus 2: 2♂ ♀ Oct.

Rhadinopsylla sectilis (fall-winter-spring) moderate distribution
Dipodomys ordii 1: ♀ March, ♀ May
Eutamias minimus 2: 2♂ March
Neotoma cinerea 1: ♂ Dec.
Onychomys leucogaster 1: ♂ March, ♂ Oct.
**Peromyscus maniculatus* 3: 4♂ 12♀ Jan., ♂ 3♀ Feb., 14♂ 16♀ March, ♀ April, ♂ 2♀ May, ♀ June, ♂ 3♀ Oct., 3♂ 3♀ Nov.
Spermophilus townsendii 6: 6♀ May

**Stenistomera alpina* (winter) limited distribution
Neotoma cinerea 6: 6♂ 6♀ Dec.

Stenistomera macrodactyla (fall-winter) limited distribution
Neotoma cinerea 1: ♂ Aug.
**Peromyscus maniculatus* 7: 3♀ Jan., 16♂ 7♀ Feb., ♀ Oct., 4♀ Nov.

**Thrassis bacchi* (summer) limited distribution
Microtus montanus 1: ♂ Aug.

**Thrassis francisi* (spring-summer) limited distribution
Dipodomys ordii 1: ♂ Aug.
Peromyscus maniculatus 4: 4♂ March
**Spermophilus townsendii* 5: ♂ March, ♂♀ April, 28♂ 39♀ May, 5♂ 20♀ June

Thrassis howelli (summer) limited distribution
Marmota flaviventris 2: 24♂ 28♀ May, 2♂ 2♀ June
Neotoma cinerea 1: ♀ Aug.

**Thrassis pandorae* (summer) limited distribution
Onychomys leucogaster 1: ♀ June
Spermophilus townsendii 1: ♀ April

Species of Questionable Placement

Catallagia sp.
Peromyscus maniculatus 1: 3♀ Aug.

Foxella sp.
Onychomys leucogaster 2: ♂ ♀ June

Malaraeus sp.
Microtus montanus 2: 1 ? sex March, 3♀ July
Neotoma cinerea 1: 4♀ Aug., ♀ Sept.
Peromyscus maniculatus 2: 5♂ May, ♀ Feb., 6♀ March, 12♀ May, 4♀ June, 10♀ July, 3♀ Aug., 3♀ Nov., ♀ Dec.

Megabothris sp.
Microtus montanus 1: ♀ July, 5♀ Aug., 8♂ 5♀ Oct.
Neotoma cinerea 1: ♀ Aug.
Peromyscus maniculatus 1: ♀ Aug., ♂ Dec.

Meringis sp.
Dipodomys ordii 2: ♂ March, 7♂ ♀ June, 4♀ July, 9♀ Aug.
Lepus californicus 1: ♀ Aug.
Onychomys leucogaster 1: ♀ Aug.
Perognathus parvus 1: ♀ Aug.
Peromyscus maniculatus 1: 5♀ July, 7♀ Aug.

Monopsyllus sp.
Peromyscus maniculatus 1: ♂ 2♀ June

Orchopeas sp.
Perognathus parvus 1: ♀ July

Pulex sp.
Peromyscus maniculatus 1: 2♀ Aug.
Vulpes fulva 12: 23♀ July

Thrassis sp.
Marmota flaviventris 1: ♂ June, ♀ Aug.
Onychomys leucogaster 1: ♀ Oct.
Peromyscus maniculatus 1: ♀ Aug.
Spermophilus townsendii 2: ♀ April, 3♀ May, 2 ♀ July

Summary of Host-Flea Associations

(* preceding flea indicates new host record)

Canis latrans
Cediopsylla inaequalis
Pulex irritans

Dipodomys ordii
**Catallagia decipiens*
Epitedia wenmanni
Foxella ignota
Meringis hubbardi
Meringis parkeri
Meringis telchinum
**Monopsyllus eumolpi*
**Monopsyllus exilis*
Monopsyllus wagneri
**Opisocrostis labis*
**Rhadinopsylla sectilis*
**Thrassis francisi*

Eutamias minimus
Catallagia decipiens
**Meringis hubbardi*
**Meringis parkeri*
Monopsyllus eumolpi
Monopsyllus wagneri
Opisocrostis labis
**Orchopeas leucopus*
Orchopeas sexdentatus
**Rhadinopsylla sectilis*

Lepus californicus
Cediopsylla inaequalis
**Meringis parkeri*
Monopsyllus wagneri
Odontopsyllus dentatus

Lynx rufus
Cediopsylla inaequalis
Odontopsyllus dentatus
**Orchopeas sexdentatus*

Marmota flaviventris
Monopsyllus wagneri
Thrassis howelli

Microtus montanus
**Amphipsylla siberica*
**Malaraeus euphorbi*
Malaraeus telchinum
Megabothris sp.
**Meringis parkeri*
Monopsyllus wagneri
**Thrassis bacchi*

Mus musculus
Monopsyllus wagneri

Mustela frenata
Foxella ignota
**Meringis hubbardi*
**Meringis parkeri*

Neotoma cinerea
Anomiopsyllus amphibolus
Epitedia wenmanni
Malaraeus bitterrootensis
Malaraeus telchinum
Megabothris sp.
Megarthroglossus divisus
**Meringis parkeri*
Monopsyllus wagneri
Thrassis acamantis
Orchopeas sexdentatus
Peromyscopsylla hesperomys
Phalacropsylla allos
**Rhadinopsylla sectilis*
Stenistomera alpina
**Stenistomera macrodactyla*
Thrassis howelli

Onychomys leucogaster
Foxella ignota
Opisocrostis labis

**Malaraeus telchinum*
Meringis hubbardi
Meringis parkeri
Monopsyllus exilis
Monopsyllus wagneri

Perognathus parvus
**Malaraeus telchinum*
Meringis hubbardi
Meringis parkeri

Peromyscus maniculatus
**Amphipsylla siberica*
Callistopsyllus terinus
Catallagia decipiens
**Cediopsylla inaequalis*
Epitedia stanfordi
Epitedia wenmanni
Foxella ignota
Hystrichopsylla occidentalis
Malaraeus telchinum
Megabothris sp.
Meringis hubbardi
Meringis parkeri

Reithrodontomys megalotis
**Meringis hubbardi*
**Meringis parkeri*
Monopsyllus wagneri

Sorex merriami
**Meringis hubbardi*
**Meringis parkeri*

Spermophilus townsendii
Meringis parkeri
**Monopsyllus eumolpi*
Monopsyllus wagneri
Opisocrostis labis

Sylvilagus idahoensis
**Cediopsylla inaequalis*
**Monopsyllus wagneri*

Sylvilagus nuttallii
Cediopsylla inaequalis
Monopsyllus wagneri

Taxidea taxus
Pulex irritans

Thomomys talpoides
Foxella ignota

Vulpes fulva
Pulex irritans

Junco oreganus
**Catallagia decipiens*
**Phalacropsylla allos*
Rectofrontia fraterna
**Rhadinopsylla sectilis*
Thrassis pandorae

Monopsyllus eumolpi
**Monopsyllus wagneri*
**Orchopeas* sp.

Monopsyllus eumolpi
**Monopsyllus exilis*
Monopsyllus wagneri
**Opisocrostis labis*
Opisodasys keeni
Orchopeas sexdentatus
Peromyscopsylla hesperomys
**Phalacropsylla paradisea*
**Pulex* sp.
Rectofrontia fraterna
Rhadinopsylla sectilis
**Stenistomera macrodactyla*
**Thrassis francisi*

Opisocrostis tuberculatus
**Rhadinopsylla sectilis*
Thrassis francisi
Thrassis pandorae

Degree of Host Infestation

Fleas of several species varied greatly in their occurrence on their preferred host between different study areas (Table 1). Greatest to lesser extremes were demonstrated by *Monopsyllus wagneri*, *Meringis parkeri*, *Monopsyllus eumolpi*, *Thrassis francisi*, and *Meringis hubbardi*, respectively. In three areas where the lowest degree of host infestation occurred, the flea-host index was higher than in most

Table 1. Extremes of host infestation and flea-host index of fleas of eleven species in selected areas.*

Flea	% hosts infested by area Highest	Lowest	Highest flea-host index by area
Catallagia decipiens	15.6 (36)	2.6 (16)	2 (17)
Epitedia wenmanni	18.2 (35)	.8 (3)	2.5 (3)
Malaraeus euphorbi	25.0 (28)	.4 (3)	4.5 (36)
Malaraeus telchinum	31.8 (36)	.8 (8)	2.2 (13)
Meringis hubbardi	51.5 (1)	0 (17)	2.9 (2)
Meringis parkeri	84.6 (14)	0 (29)	6.4 (10)
Monopsyllus eumolpi	83.3 (23)	11.1 (7)	5.3 (2)
Monopsyllus wagneri	100 (38)	0 (29)	7 (9)
Opisodasys keeni	4.9 (36)	.4 (3)	2.2 (36)
Rhadinopsylla sectilis	13.9 (36)	.8 (3)	6.8 (3)
Thrassis francisi	90.9 (3)	20.0 (9)	4 (9)

*Area in parentheses.

other areas. The flea-host index was high in only two areas where the degree of host infestation was also high. In three other areas where the flea-host index was high, the degree of host infestation was only moderate.

Host Abundance and Species Variety

In some cases the number of different fleas found on a particular host was directly proportional to the number of hosts examined (Table 2). This may be expressed as the more common the host, the greater the variety of fleas it possesses. This was demonstrated by

Table 2. Number of mammals examined and number of species of fleas found on each kind.

Host	No. examined	Species of fleas
Peromyscus maniculatus	1866	27
Dipodomys ordii	808	12
Perognathus parvus	474	6
Eutamias minimus	398	9
Lepus californicus	125	5
Plecotus townsendii	78	0
Onychomys leucogaster	63	11
Spermophilus townsendii	60	8
Reithrodontomys megalotis	39	3
Sylvilagus nuttallii	28	2
Microtus montanus	25	7
Neotoma cinerea	14	15
Sylvilagus idahoensis	13	3
Sorex merriami	9	2
Lynx rufus	8	4
Thomomys talpoides	8	1
Marmota flaviventris	6	3
Canis latrans	6	2
Taxidea taxus	5	1
Mustela frenata	4	3
Vulpes fulva	4	1
Mus musculus	1	1

Peromyscus maniculatus, *Dipodomys ordii*, *Eutamias minimus*, *Onychomys leucogaster*, and *Spermophilus townsendii*. Conversely, some hosts taken in abundance had relatively few species of fleas on them, such as *Perognathus parvus*, *Lepus californicus*, *Plecotus townsendii*, *Reithrodontomys megalotis*, and *Sylvilagus nuttallii*. Still other animals, although relatively unabundant, possessed a greater variety of fleas than would normally be expected. These were *Neotoma cinerea*, *Microtus montanus*, and *Lynx rufus*.

Degree of Infestation by Sex

Where sufficient numbers were taken to be indicative of rates of infestation, most fleas showed little if any difference relative to sex relationships. Significant differences were present, however, for fleas of seven species on hosts of eight species (Table 3). On hosts of three species, male fleas were much more abundant on the male hosts than on the female. The reverse situation occurred with hosts of two species where the male fleas were much more abundant on the female hosts than on the male. Female fleas were more abundant on the male hosts than on the female of four species, whereas on hosts of another species the female fleas were more abundant on the female hosts than on the male.

Seasonal Occurrence

Fleas were taken every month of the year, but the greatest number of species (23) was taken in August, and the least number (11) in February. The seasonal occurrence and number of species taken

Table 3. Relative degrees of infestation by male and female fleas on hosts of different sexes.

	Flea-host index*			
	Male fleas on		Female fleas on	
Flea and host	♂ hosts	♀ hosts	♂ hosts	♀ hosts
Cediopsyllus inaequalis				
Lepus californicus	1.3	3.0	2.1	2.6
Sylvilagus nuttallii	5.0	10.8	5.0	4.1
Foxella ignota				
Onychomys leucogaster	6.0	3.6	8.5	3.4
Meringis hubbardi				
Peromyscus maniculatus	1.2	1.0	2.6	1.3
Meringis parkeri				
Perognathus parvus	2.5	1.0	1.7	1.1
Monopsyllus eumolpi				
Eutamias minimus	1.8	2.4	2.1	4.5
Orchopeas sexdentatus				
Neotoma cinerea	7.0	5.5	17.0	7.8
Thrassis francisi				
Spermophilus townsendii	2.0	2.3	4.5	2.8

*Total number of fleas divided by total number of infested hosts.

was winter 2, spring 2, summer 13, fall 3, winter-spring 1, spring-summer 1, summer-fall 3, fall-winter 2, fall-winter-spring 1, spring-summer-fall 1, year round 12.

Species Interaction

Whether competition between fleas on the same host actually exists is not known, but host specificity and relative numbers on the same host as observed in these studies are suggestive that the phenomenon does exist. Should species interaction occur, it is expected that the ratio of times a species occurs as the only one on the host would be great. Conversely, where little interaction is demonstrated, the greater the ratio of times a species may be expected to occur in association with others. Data for five species were indicative of considerable interaction, and for eight, a lesser degree (Table 4). *Cediopsylla inaequalis* and *Monopsyllus eumolpi* demonstrated greatest reaction, and *Monopsyllus exilis* and *Malaraeus euphorbi* the least.

Table 4. Frequency of species associations for some commonly collected fleas.

Flea	Ratio of times found	
	Alone	With other species
Cediopsylla inaequalis	4	1
Monopsyllus eumolpi	4	1
Meringis parkeri	3	1
Monopsyllus wagneri	3	1
Thrassis francisi	2	1
Meringis hubbardi	1	1
Orchopeas sexdentatus	1	2
Foxella ignota	1	4
Catallagia decipiens	1	6
Malaraeus telchinum	1	8
Rhadinopsylla sectilis	1	8
Epitedia wenmanni	1	9
Malaraeus euphorbi	1	11
Monopsyllus exilis	1	12

Study Area Relationships of Fleas

No apparent correlation between the number of species of fleas found and a predominant plant type was evident. However, there was some variance in the number of species found in different study areas (Table 5). It is expected that the number of species of fleas found should be directly proportional to the number and kinds of hosts examined in a given area. In areas 4, 6, 9, 21 and 39 the numbers of species of fleas found were less than expected, whereas in areas 14, 23, 24, 28, 32, 33, 35, 37, 38 and 40 the numbers were greater. This may be indicative that the former areas are not as favorable for the survival and reproduction of fleas as are the latter ones.

Table 5. Numbers of species of fleas in proportion to numbers and kinds of hosts examined in selected study areas.

Area	No. species of fleas Expected*	Actual
4	7-8	4
6	10-11	5
9	8-9	5
14	3-4	6
17	1	7
21	12	2
23	3-4	9
24	1	7
28	1	7
32	3	10
33	1-2	6
35	1	4
37	1-2	6
38	2-3	8
39	8	2
40	3-4	5

*Approximation based on the relative numbers and kinds of hosts examined in relationship to fleas found in all other study areas.

Radiation Influence

Comparative rates of host infestation and flea-host indices showed some differences between a radioactive waste burial ground and an ecologically similar control area (Table 6). Although there was little difference in the flea-host index of the two areas, in four of five cases approximately twice as many mammals were infested with fleas in the control area than in the irradiated area. This lower infestation rate is not necessarily due to the effects of radiation, but more likely is due to the effect of sorptive dusts resulting from physical disturbance of the area (excavation, grading, and plant removal).

Table 6. Variations in degree of infestation between an irradiated area and a non-irradiated control plot.

Flea	Irradiated area 13 Flea-host index	Irradiated area 13 % hosts infested	Non-irradiated area 38 Flea-host index	Non-irradiated area 38 % hosts infested
Foxella ignota	2	50	2.5	100
Malaraeus telchinum	2.2	7.5	1	13.6
Meringis parkeri	2.5	21.1	2.3	33.3
Monopsyllus eumolpi	3.3	55	2.5	44.4
Monopsyllus wagneri	6.9	51.4	4.9	100

Geographic Distribution

The geographic distribution of a species of flea usually is related to the geographic range and variety of its hosts. In this study this generally was the case, and those fleas which were found on the

greatest variety of hosts demonstrated the most widespread geographic distribution (Table 7). Some exceptions were noted, however, wherein this correlate did not hold true. *Foxella ignota*, *Malaraeus telchinum*, *Monopsyllus eumolpi*, and *Orchopeas sexdentatus* were widely distributed, yet were not found on as many hosts as some other species. Conversely, *Catallagia decipiens* and *Opisocrostis labis* were not widely distributed, yet occurred on a greater variety of hosts than some other species.

Species Variation

Amphipsylla siberica. These specimens are similar to the subspecies *pollionis* from Alaska.

Cediopsylla inaequalis. Beck identified males of series 3169 and 3170 from *Lynx rufus* as subspecies *interrupta.* These were in company with subspecies *inaequalis* which predominates on lagomorphs and some of its predators, *Lynx rufus* and *Canis latrans.* Jellison examined both males and females of a series and designated the males as *inaequalis.*

Malaraeus bitterrootensis. A male of series 2647 has features of both this species and *M. euphorbi.* Differences are the basal hook on the 8th sternite of *bitterrootensis*, and the distal part of the sternite which on this specimen has only one long seta, whereas typical *bitterrootensis* has several.

Malaraeus euphorbi. Jellison tentatively assigned two females of series 5855 to the *euphorbi* group because of their similarity to species figured by Stark (1958). Another two females of series 5827

Table 7. Species of greatest abundance (arranged in diminishing order of geographic distribution) and number of species of hosts on which found.

Species	No. of areas in which found	No. of hosts on which found
Monopsyllus wagneri	34	14
Meringis parkeri	28	12
Monopsyllus eumolpi	22	5
Meringis hubbardi	20	8
Foxella ignota	14	5
Rhadinopsylla sectilis	13	6
Malaraeus telchinum	12	5
Orchopeas sexdentatus	11	4
Cediopsylla inaequalis	10	6
Epitedia wenmanni	10	3
Malaraeus euphorbi	10	2
Monopsyllus exilis	9	3
Opisocrostis labis	9	5
Thrassis francisi	7	3
Catallagia decipiens	6	4
Opisodasys keeni	6	1
Stenistomera macrodactyla	5	2
Rectofrontia fraterna	2	2
Thrassis howelli	2	2

were designated as distinct from those of 5855, and probably are not *M. telchinum*.

Megabothris obscurus. A male of series 3098 was designated by Beck as having some variations from the original description of this species. Jellison designated a number of females from a variety of hosts, series 5164, 5435, 5566, 5800 and 5827, as probably this species.

Meringis hubbardi. Beck had some question on several specimens which were very similar to *M. parkeri*, but called them *hubbardi* on the basis of Stark's (1958) drawing. Jellison designated a group of males from series 76, 1437, 1438, 1689, 2010, 2032 and 2072 as not typical *hubbardi* or *parkeri*, and suggested that these may be abnormal males as figured by Hopkins and Rothschild (1953-1962). Some females of series 1437, 1934, 2032, 2072, 2098, 5638, 5700, 5719, 5723, 5756 and 5757 Jellison designated only as of the *parkeri-hubbardi* group.

Orchopeas sexdentatus. Jellison observed a great variation in sternite 7 of the females in series 5826.

Rectofrontia fraterna. Beck indicated that in the Idaho specimens the 9th sternite of the male is not as figured by Holland (1949).

Thrassis bacchi. Jellison designated these as subspecies *gladiolis*. Two females of series 4893 have numerous apical spinelets on the metanotum similar to those on *T. aridis*.

Thrassis francisi. Beck indicated that some of these specimens are very similar to *T. howelli*, although the finger of some males is broader than shown in illustrations.

Thrassis howelli. Jellison designated these as belonging to the subspecies *utahensis*. However, on many fleas of the series 3896 the posterior dorsal edge of tergite VIII of the males is nude, whereas in most published illustrations there are several long setae present. The distal posterior edge of sternite VIII is likewise not as hirsute as in the illustrations.

Summary

Fleas of 38 species were collected from mammals of 21 species and one species of bird between June, 1966 and September, 1967 at the National Reactor Testing Station in Idaho. Almost two-thirds of the species collected represent new records for Idaho, and over 40 collections represent new host records. Twenty-one of the species are of medical importance in plague transmission as demonstrated by findings in nature or experiments in the laboratory (Stark, 1958). Fourteen of these important species have a limited geographic distribution at the station, five are moderately distributed, and two demonstrate a wide-spread distribution. The greatest number of species was taken in August. Most species showed little if any difference relative to sex relationships and degree of host infestation. The num-

ber of species of fleas infesting a particular host was not directly proportional to the numbers of hosts examined in all cases. Frequencies of simultaneous occurrence of fleas of two different species on the same host were indicative that species competition may occur in some instances. There was no apparent correlation between the number of species of fleas and a predominant plant type in any area, although variations in numbers did occur between different study areas. The geographic distribution of fleas at the station was related to the geographic range and variety of their hosts. Species of fleas infesting the greatest variety of hosts were *Monopsyllus wagneri*, *Meringis parkeri*, and *Meringis hubbardi*. Mammals infested by the greatest variety of fleas were *Peromyscus maniculatus*, *Neotoma cinerea*, *Dipodomys ordii*, *Onychomys leucogaster*, *Eutamias minimus*, *Spermophilus townsendii*, and *Microtus montanus*. Comparative rates of infestation between an irradiated area and a non-irradiated control area showed that twice as many animals were infested in the control area as in the irradiated plot.

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A KEY TO SPECIES OF THE *CNESINUS* LECONTE (COLEOPTERA: SCOLYTIDAE) OF NORTH AND CENTRAL AMERICA[1]

Stephen L. Wood[2]

In my recently completed review of the North and Central American bark beetle tribe Bothrosternini (Scolytidae) 32 species in the large and difficult genus *Cnesinus* LeConte were recognized. Because two-thirds of the species from the area have been named since the key in Biologia Centrali-Americana appeared, and because several years will elapse before my treatis will be published. the key to species and descriptions of previously undescribed species of *Cnesinus* from Mexico and Central America are presented on the following pages. The new *Cnesinus* species are from Mexico (2). Honduras (1), and Costa Rica (7); one of the Costa Rican species also occurs in Panama. In addition, one species of *Bothrosternus* from both Costa Rica and Panama is included.

The neotropical genus *Cnesinus* is represented in South America by approximately 35 additional species; one species occurs in the United States.

Key to the *Cnesinus* North of Panama

1. Elytral vestiture confined to declivity, hairlike; pronotal punctures usually elongate but ordinarily not strongly strigose; female frons without a transverse carina, an epistomal elevation may occur in either sex; striae usually less strongly impressed. the punctures larger and usually impressed individually (except *retifer*); interstrial punctures tending to be uniseriate (several exceptions) 2

   Elytral vestiture abundant, extending to base. scalelike, less commonly hairlike; pronotum longitudinally strigose (except *frontalis*); frons of one sex or both commonly with a carina or other prominent elevation; striae commonly abruptly, deeply impressed, the punctures usually partly confluent or even obsolete; interstrial punctures usually more abundant, confused 17

2(1). Frons devoid of an epistomal elevation in both sexes, male without conspicuous epistomal ves-

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2. Department of Zoology and Entomology, Brigham Young University, Provo, Utah. Scolytoidea Contribution No. 37.

titure; entire frontal area dull, reticulate, lower area at most flattened, upper area rather strongly, broadly convex; small species, 1.6-2.2 mm. 3

Frons with a conspicuous epistomal callus or other elevation, male sometimes also female, with at least one transverse row of stout setae on upper margin or upper slope of callus; frontal area usually partly or entirely shining, moderately to strongly impressed on at least part of lower half; size variable, 1.5-3.5 mm. 5

3(2). Surface of pronotum and elytra reticulate, dull; strial punctures confluent, almost entirely obsolete; declivital bristles stout, spaced within a row by distances equal to two-thirds length of a bristle, between rows by length of a bristle; Panama; 1.8-2.0 mm. (Fig. 1) ..... *retifer* Wood

Surface of pronotum and elytra shining; strial punctures distinct; declivital bristles somewhat more slender, spaced within rows and between rows by length of a bristle 4

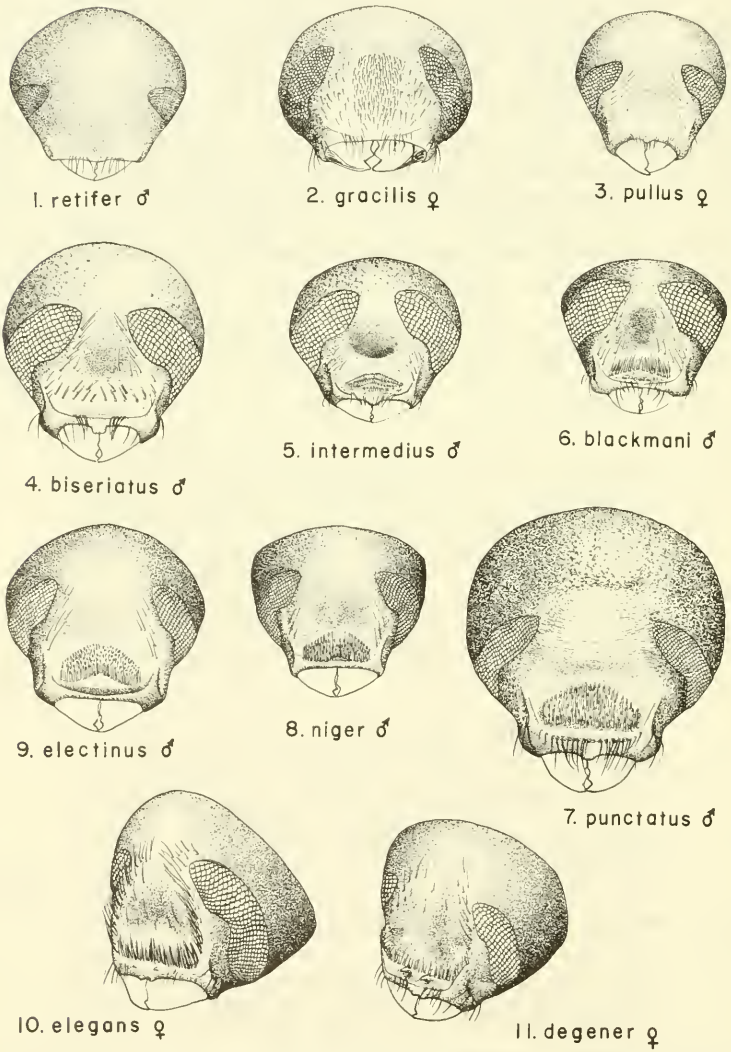
4(3). Eyes separated by 2.2 times width of an eye; female frons between upper part of eyes transversely convex and ornamented by abundant, fine, moderately long, yellowish hair; convexity of male frons more pronounced and extensive, not more than lower third flattened; declivital striae 2 and 3 equally impressed; interspace 2 devoid of granules, 3 sometimes with a few minute granules; Costa Rica to Panama; 1.8-2.1 mm. (Fig. 2) ..... *gracilis* Blandford

Eyes separated by 1.5 times width of an eye; female frons transversely flat, vestiture sparse, inconspicuous; lower half of male frons flattened; declivital striae much more strongly impressed than 2, interspaces 2 and 3 each armed by a row of rounded granules; Panama; 1.5-1.8 mm. (Fig. 3) ..... *pullus* Blandford

5(2). Female epistomal callus unarmed by tubercles, male callus bearing on dorsal slope a tuft of uniformly short, stout, decorative bristles (except only one row in *bicostatus* in which eyes separated by much less than width of an eye); smaller species, 1.6-2.9 mm. 6

Female epistomal callus armed by a pair of pointed tubercles, or by a large, unpaired elevation,

male callus ornamented by not more than one uniseriate, transverse row of only slightly modified decorative bristles; eyes always separated by a distance at least as great as width of an eye; larger species, 2.5-3.9 mm. 12



Figs. 1-11. Cephalic aspect of heads of *Cnesinus* spp.: 1, *retifer;* 2, *gracilis;* 3, *pullus;* 4, *bicostatus;* 5, *intermedius;* 6, *blackmani;* 7, *punctatus;* 8, *niger;* 9, *electinus;* 10, *elegans;* 11, *degener.*

6(5). Eyes separated by less than 1.0 times width of an eye 7

Eyes separated my more than 2.0 times width of an eye 9

7(6). Male epistomal callus poorly developed, its lower slope descending gradually, the upper slope ornamented by only one transverse row of ornamental bristles; declivital interspaces 1 to 3 feebly if at all convex; declivital interstrial vestiture consisting of rows of erect bristles and moderately sparse, fine, supplemental hair; Costa Rica; 2.3-2.6 mm. (Fig. 4) ..... *bicostatus* Schedl

Epistomal callus of male abruptly precipitous below, its upper slope ornamented by numerous bristles not confined to a single row; declivital interspaces rather narrowly convex; declivital vestiture consisting entirely of rows of erect, interstrial bristles; smaller species 8

8(7) Ornamental bristles on male epistomal callus longer, about equal in length, thickness and color to those on other frontal areas above; punctures on anterolateral area of pronotum elongate, rarely confluent; punctures of pronotum and elytra very slightly larger; Costra Rica; 1.6-1.9 mm. (Fig. 5) ..... *intermedius* Schedl

Ornamental bristles on male epistomal callus reddish in color, about half as long as the more slender yellowish setae on other frontal areas; punctures on anterolateral area of pronotum elongate and many confluent, appearing more nearly substrigose; punctures of pronotum and elytra very slightly smaller; Mexico to Colombia; 1.7-1.9 mm. (Fig. 6) ..... *blackmani* Schedl

9(6). Body stout, less than 2.1 times as long as wide; Mexico to Panama; 2.2-3.0 mm. (Fig. 7) ..... *punctatus* Blandford

Body more slender, at least 2.4 times as long as wide; smaller species, 2.0-2.5 mm. 10

10(9). Pronotum rather deeply, coarsely punctured, the punctures mostly very elongate (about three or more times as long as wide), substrigose; interstriae more narrowly convex, only slightly wider than striae; Panama; 2.0-2.5 mm. (Fig. 8) ..... *niger* Wood

Pronotum with rather fine, shallow punctures, the punctures oval, rarely as much as twice as

long as wide (one specimen very shallowly, minutely substrigose); interstriae less strongly convex, almost twice as wide as striae 11

11(10). Lower margin of male epistomal callus sharply, rather precipitously defined along an almost straight, transverse line; body 2.6 times as long as wide, pronotum with minute points between punctures (at 40 diameters magnification); striae less strongly impressed; Mexico; 2.1-2.5 mm. (Fig. 9) ..... *electinus* Wood

Lower margin of male epistomal callus not sharply defined, with a fine median tubercle (absent in a few specimens) on lower margin; body 2.4 times as long as wide; pronotum with minute points scarcely visible at 80 diameters; striae more strongly impressed; Mexico; 2.0-2.4 mm. ..... *myelitis* Wood

12(5). Female epistomal callus armed by a pair of pointed tubercles; declivital interstriae feebly if at all convex, armed by rows of fine granules 13

Female epistomal area armed by an unpaired median elevation; declivital interstriae narrowly convex, not high, entirely unarmed 16

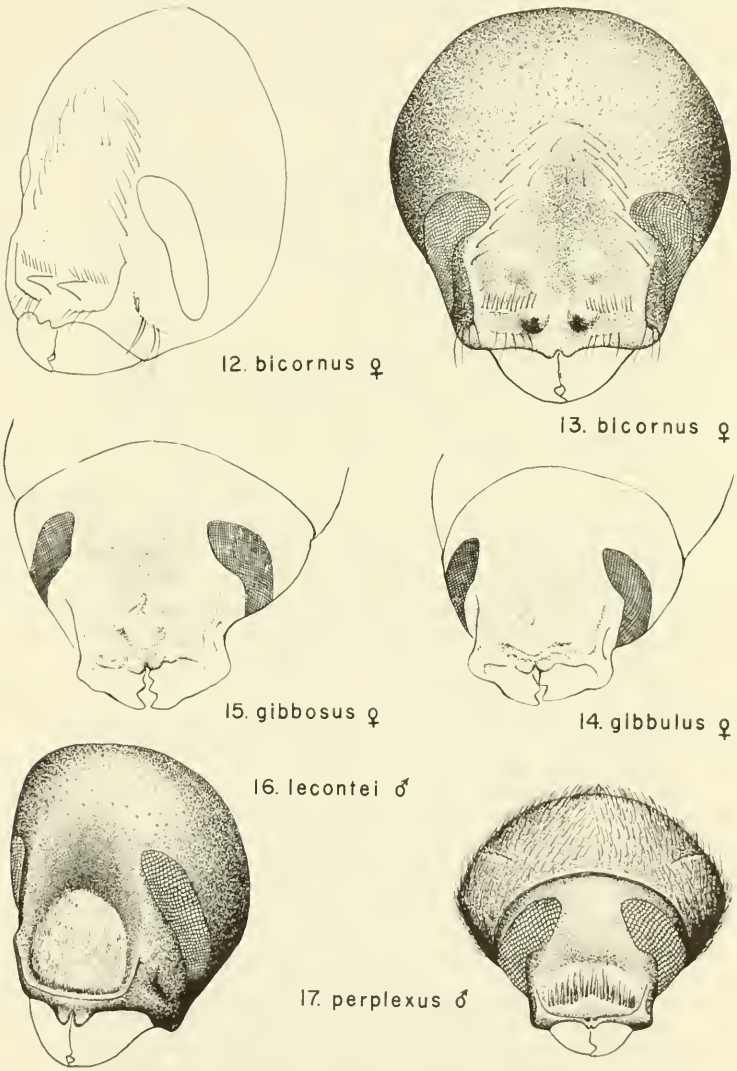
13(12). Frons concavely impressed to slightly above upper level of eyes, the female epistomal tubercles very large; pronotal punctures obsolete, surface strongly, longitudinally strigose; discal interstriae each armed by median row of rounded granules; Mexico; 3.3-3.8 mm. (Figs. 12-13) ..... *bicornus* Wood

Frontal impression ending well below upper level of eyes, the female epistomal tubercles much smaller; pronotum substrigose, the elongate punctures distinct; discal interstriae unarmed by granules; smaller species 14

14(13). Elytral vestiture extending to disc, the ground vestiture rather abundant, stout; discal interstriae with fine granules; body stout, 2.4 times as long as wide; female frons more deeply impressed, almost flat between eyes; Mexico; 2.0-2.3 mm. (Fig. 11) ..... *degener* Wood

Elytral vestiture usually absent on disc, ground vestiture (when present) fine, hairlike; body more slender, more than 2.7 times as long as wide; female frons more strongly convex between the eyes; larger, 2.4-3.4 mm. 15

15(14). Frontal vestiture fine, shorter, less abundant; tubercles on female epistomal callus moderately large, sharply pointed; pronotum more strongly strigose; elytral striae more strongly impressed; declivital punctures slightly larger; Guatemala; 3.0-3.4 mm. ..... *elegantis* Wood



Figs. 12-17. Cephalis aspect of heads of *Cnesinus* spp.: 12-13, *bicornus*; 14, *gibbulus*, all setae omitted; 15, *gibbosus*, all setae omitted; 16, *lecontei*; 17, *perplexus*, including anterior part of pronotum.

Frontal vestiture rather coarse, longer, more abundant; tubercles on female epistomal callus small, sometimes obscure; pronotum less strongly strigose; elytral striae less strongly impressed; declivital punctures slightly smaller; Mexico to Honduras; 2.4-2.8 mm. (Fig. 10) ..... *elegans* Blandford

16(12). Epistoma armed by a large elevation, its sides precipitous, its summit subtriangularly flattened, the lower margin arcuate, the upper margins straight and pubescent; declivital interspace 2 convex and punctured along its summit; Costa Rica; 2.4-2.8 mm. (Fig. 14) ..... *gibbulus* Wood

Epistoma armed by a large pentagonal elevation, its sides precipitous, flattened on its summit, the two dorsal sides pubescent; declivital interspace 2 convex, its punctures displaced to its mesal base, the convexity impunctate; Costa Rica; 2.8-3.5 mm. (Fig. 15) ..... *gibbosus* Wood

17(2). Female frons not armed by a transverse carina; male frons rather broadly impressed at least on lower half, extending in some species to above upper level of eyes; male epistoma variable, the ornamental bristles usually more extensive (entirely absent in *annectens*) 18

Female frons armed by a transverse carina well above epistomal area and below upper level of eyes; males of several species lack a frontal impression, the impression never extending more than half the distance from epistomal margin to upper level of eyes; male epistoma ornamented by only one uniseriate, transverse row of bristles (a double row in one species) 21

18(17). Male frons flattened to well above level of eyes, the lower and median three-fourths occupied by a subcircular, very minutely, densely pilose area; female frons broadly, subconcavely impressed on lower two-thirds of area below upper level of eyes; vestiture on pronotum and on elytral disc fine, hairlike; Guatemala to Panama; 2.7-3.3 mm. (Fig. 16) ..... *lecontei* Blandford

Male frons strongly impressed below, the impression ending below upper level of eyes; epistomal callus developed, the specialized bristles much less extensive, either entirely absent or much longer; epistomal callus evident in female and usually ornamented by a transverse row of setae on its upper margin; setae on elytral disc

at least partly stout, almost scalelike; smaller species 19

19(18). Anterolateral angles of pronotum armed by a row of small, basally contiguous asperities; ground vestiture on elytral disc hairlike, the median row of stout bristles on each interspace at least as long as distance between rows and spaced within rows by similar distances; Costa Rica; 2.0-2.3 mm. (Fig. 17) ..... *perplexus* Wood

Anterolateral angles of pronotum unarmed; elytral ground vestiture on disc stout, more than half as long as erect bristles, the bristles more closely spaced within the row, not more than two-thirds as long as distance between rows 20

20(19). Male frontal impression extending two-thirds of distance to upper level of eyes, convex above; epistomal callus narrowly carinate, occupying median two-thirds, its upper slope and lower third (or more) of impressed area bearing long, reddish, ornamental bristles; female epistomal callus evident, one transverse row of simple setae present; pronotum more coarsely strigose; strial punctures largely confluent; declivital striae rather strongly impressed; Mexico; 2.2-2.5 mm. ..... *atavus* Wood

Male frontal impression extending about to upper level of eyes; epistomal callus reduced, not occupying more than median half in either sex, not ornamented by setae, except for long, fine, hair on lateral and upper margins of impression of male; pronotum obscurely strigose, rather closely granulose; strial punctures mostly distinct; declivital striae only moderately impressed; Honduras; 1.9-2.5 mm. ..... *annectens* Wood

21(17). Elytral striae on disc very strongly impressed, the sutural interstriae carinate, others essentially bicarinate, with median area subsulcate and uniseriately punctured between elevated margins, vestiture hairlike; female carina almost straight, extending from eye to eye at level of occular emargination 22

Discal interstriae flat or convex, never carinate, punctures confused, vestiture usually abundant, scalelike; female carina crescent-shaped, the arms extending dorsolaterad, usually shorter and usually located somewhat lower on frons 23

22(21). Smaller, 2.0-2.3 mm.; female frons above carina shining, usually with a few minute points; ground vestiture on elytral declivity less abundant, the major setae usually finer and longer; pronotal rugae usually slightly coarser; Panama and Costa Rica (Fig. 18) ..... *costulatus* Blandford

Larger, 2.8-3.1 mm.; female frons above carina reticulate, dull; declivital ground vestiture more abundant, the major setae usually coarser and shorter; pronotal rugae usually finer; Guatemala to Venezuela (Fig. 19) .... *porcatus* Blandford

23(21). Elytral apices extended posteriorly and broadly emarginate at suture; declivital interspaces 1, 5 and 9 elevated; discal ground vestiture on elytra consisting of broad scales, each scale almost as wide as long; Costa Rica and Panama; 1.7-2.1 mm. (Fig. 20) ..... *squamosus* Wood

Elytra rather broadly rounded behind, the discal vestiture on elytra slender, each seta at least four times as long as wide; declivital interstriae not conspicuously elevated 24

24(23). Female transverse frontal carina occupying more than two-thirds width of frontal area (at level of antennal bases), its lower margin (in median area) at level of antennal insertion; punctures of pronotum rather large, not oriented in longitudinal rows, rarely confluent; elytral vestiture consisting of rows of long slender bristles to base, the very short, sparse, ground vestiture confined to declivity; Costa Rica; 2.0-2.3 mm. (Fig. 21) .... *frontalis* Wood

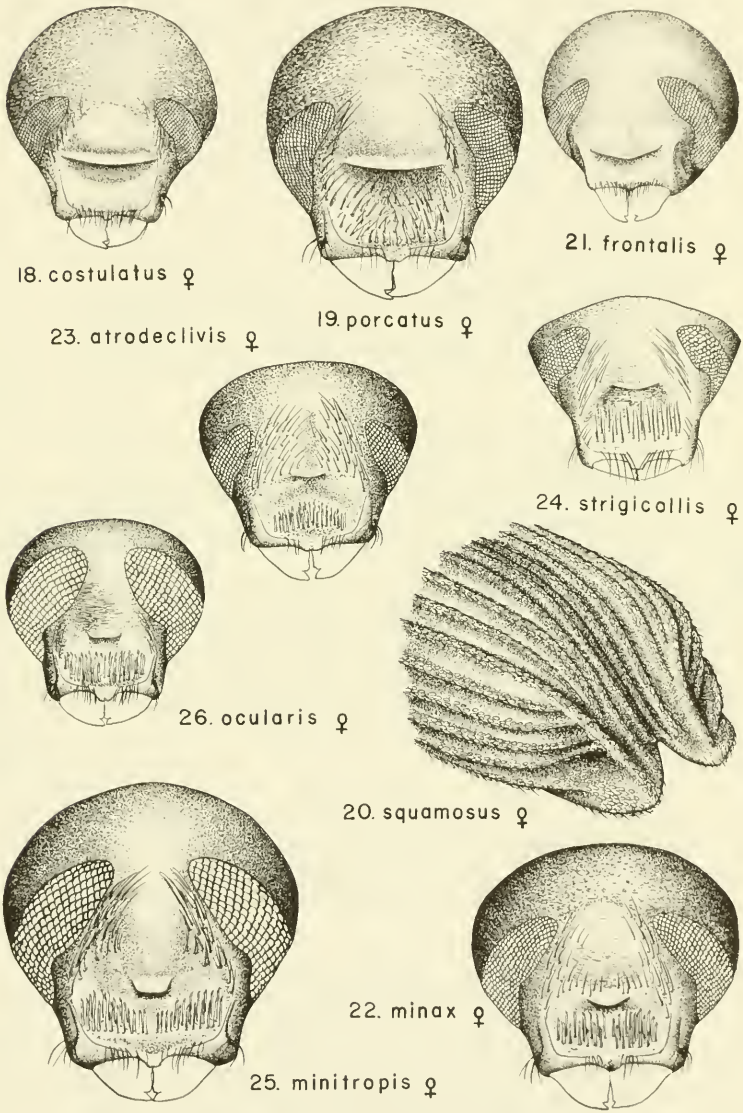
Female carina much shorter, usually located well above level of antennal bases; punctures of pronotum mostly oriented in longitudinal rows of four or more entirely obliterated by longitudinal confluence; ground vestiture on elytra more widely distributed and usually proportionately longer 25

25(24). Eyes more widely separated, separated by at least 1.8 times width of an eye 26

Eyes more narrowly separated, separated by less than 1.6 times width of an eye (if doubtful, female frontal carina short) 30

26(25). Female transverse frontal carina narrow, width of frons at level of antennal insertion more than 4.0 times transverse length of carina 27

Female carina broad, width of frons at level of antennal insertion less than 2.9 times transverse length of carina 29



Figs. 18-26. Cephalic aspect of heads or posterolateral aspect of elytral declivity (no. 20) of *Cnesinus* spp. 18, *costulatus;* 19, *porcatus;* 20, *squamosus;* 21, *frontalis;* 22, *minax;* 23, *atrodeclivis;* 24, *strigicollis;* 25, *minitropis;* 26, *setulosus.*

27(26). Female frons rather strongly, transversely impressed immediately above carina, rather strongly convex at and above upper level of eyes; female carina very strongly elevated, almost as high as transverse length of apex; most of setae in declivital ground vestiture almost as wide as long, the longer, erect setae almost twice as long as ground vestiture; Costa Rica and Panama; 1.8-1.9 mm. ..... *denotatus* Wood

Female frons more nearly flattened, the carina much less strongly elevated; setae in declivital ground vestiture slender, usually four or more times as long as wide and two-thirds or more times as long as major setae 28

28(27). Female frons weakly convex above carina; female carina conspicuously elevated; eyes separated by 1.8 times width of an eye; declivital striae feebly impressed; Mexico; 2.5-3.3 mm. (Fig. 22) ..... *minax* Schedl

Female frons flattened from just below carina to above upper level of eyes; female frontal carina low, feebly elevated; eye separated by 2.2 times width of an eye; declivital striae rather strongly impressed; Honduras; 0.2-2.3 mm. (Fig. 23) ..... *atrodeclivis* Wood

29(26). Discal vestiture on elytra rather coarse, the major, erect setae blunt, wider distally; female frontal carina longer, the distance between eyes only 1.8 times length of carina; interstrial granules on declivity moderately large; southeastern United States; 2.2-2.7 mm. (Fig. 24) ..... *strigicollis* LeConte

Discal vestiture on elytra fine, the major erect setae usually pointed, not expanded distally; female frontal carina shorter, the distance between eyes 2.4 times length of carina; interstrial granules on declivity absent; Mexico; 2.5-3-1 mm. ..... *carinatus* Wood

30(25). Striae on elytral declivity more strongly impressed, the interspaces rather narrowly convex (except lower half of 2 in some specimens) and each armed by a row of small rounded granules; distance between eyes exceedingly variable, 0:6-1.6 times width of an eye, but commonly constant within a series, possibly a polytypic species; Mexico to Panama; 1.8-2.6 mm. ..... *setulosus* Blandford

Declivital striae feebly if at all impressed, the interstriae not elevated or armed by granules (occasional males with feeble granules on upper half); eyes separated by 1.0 or more times width of an eye; larger species 31

31(30). Frontal carina in female longer, the distance between eyes less than 3.5 times as long as carina; discal interstriae armed by sparse rows of very fine, rounded granules; longest declivital bristles usually much more than twice as long as ground scales; Honduras to Columbia; 2.6-3.3 mm. ..... *adusticus* Wood

Frontal carina in female short, low, the distance between eyes more than five times greater than length of carina; discal interstriae devoid of granules; longest bristles on elytral declivity usually much less than twice as long as ground vestiture; Costa Rica; 3.0-3.5 mm. ..... *minitropis* Wood

Species Omitted

Two described species from Mexico are unknown to me except for the original descriptions and notes recently supplied by their author Dr. K. E. Schedl. According to Schedl's notes *quaesatus* Schedl and *garrulus* Schedl (An. Esc. Nac. Cienc. Biol., Mexico 1:331, 332. 1940) would fit into the above key near *elegantis* and *gibbulus*. He considered the male type of *quaesatus* to be synonymous with *gibbulus*. However, males of *elegantis* and *gibbulus* are almost indistinguishable. Since both are known only from the type series, Guatemala and Costa Rica respectively, it would appear the suspected synonymy is incorrectly applied to the Mexican *quaesatus* and it will be necessary to await availability of the type to resolve the question.

The type of *garrulus* evidently is a female of a distinct species closely allied to *gibbulus;* it has a much smaller, more nearly tuberculate, median, epistomal elevation than does the latter species. It is entirely possible *quaesatus* and *garrulus* could represent opposite sexes of one species.

The species represented in the key by the names *setulosus* and *paleatus* is an unusually variable species with respect to the size and spacing of eyes and in the sculpture of the pronotum. Although individual series may be very constant with respect to these characters, almost no two series are exactly the same. Because of this it is very possible that *setulosus*, *paleatus* and possibly *ocularis* represent only extreme examples of the same species.

It will be noted that several names of species described from Central America and Mexico have been omitted from the key. These names were omitted because of synonymy that will be published in

a later paper. A possible exception may be *adustus* Schedl which cannot be correctly determined until the type is available for study.

Cnesinus gibbulus, n. sp.
Fig. 14

This species and *gibbosus*, described below, are rather closely related. According to Schedl, who examined a specimen of *gibbosus*, they are allied to *gibbus* Chapuis, from Venezuela. Among species of this genus known to me they are unique. They can easily be distinguished from one another by characters given in the key to species above.

Female.— Length 2.6 mm. (paratypes 2.4-2.8 mm.), 2.5 times as long as wide; color dark brown.

Frons transversely, concavely impressed at level of antennal bases, convex above, lower area largely occupied by a large median rhomboidal (subtriangular in some specimens) elevation, wider than long, with sides precipitous, the upper two sides closely pubescent, the elevation near but not reaching epistomal margin; flattened surface of elevation and convex surface above very minutely, transversely substrigose, lateral areas and vertex with fine punctures; vestiture other than on brush of elevation, sparse, inconspicuous, limited to lateral areas.

Pronotum 1.06 times as long as wide; sides straight and parallel on basal two-thirds, broadly rounded in front; punctures rather small, deep, mostly less than twice as long as wide, about a third of them confluent; scanty vestiture limited to anterior area and margins.

Elytra 1.6 times as long as wide, 1.9 times as long as pronotum; sides almost straight and parallel to declivital base, broadly rounded behind; striae impressed, the punctures rather small, individually, rather deeply impressed; interspaces about twice as wide as striae, marked by a few irregularly placed transverse lines, the punctures small, shallow, in rather indefinite rows. Declivity convex, steep; striae 1 rather strongly impressed, others less strongly impressed, the impression reduced toward apex; interstriae moderately convex, with small, deep punctures. Vestiture largely confined to declivity, fine hairlike, rather long, mostly in interstrial rows except absent on sutural interstriae.

Male.— Similar to female except elevation reduced to a low, transverse, medially impressed ridge, pubescence equal to female; transverse frontal impression long and with a pair of small, rounded, lateral calluses; and elytral declivity more strongly impressed medially.

Type Locality.— Villa Mills on Cerro de la Muerte, Cartago Prov., Costa Rica.

Host.— *Quercus* sp.

Type Material.— The female holotype, male allotype, and 14 paratypes were collected at the type locality on June 26, 1966

(labeled August 1 in error), at an elevation of 3,100 m., by S. L. Wood, from a small broken oak branch.

The holotype, allotype, and paratypes are in my collection.

Cnesinus gibbosus, n. sp.

Fig. 15

The only allied species known to me is *gibbulus*, described above, from which this species is readily distinguished by characters given in the key to species above.

Female.— Length 3.3 mm. (paratypes 2.8-3.5 mm.), 2.5 times as long as wide; color dark brown.

Frons strongly, transversely impressed just above level of antennal bases, convex above, flattened below, with median half occupied by an abruptly elevated, flat, pentagonal elevation reaching almost to epistomal margin, upper two sides ornamented by a row of stout bristles, the process higher and narrower than in *gibbulus;* upper area almost smooth, with a few punctures and inconspicuous setae in lateral areas and on vertex.

Pronotum 1.05 times as long as wide; sides straight and parallel on more than basal half, broadly rounded in front; punctures fine, deep, each three or four times as long as wide, about two-thirds of them confluent; vestiture inconspicuous except at margins, but covering entire surface.

Elytra 1.5 times as long as wide, 1.7 times as long as pronotum; sides straight and parallel to base of declivity, rather broadly rounded behind; striae impressed, the punctures small and individually impressed; interstriae about twice as wide as striae, dull, the punctures small, rather numerous, confused. Declivity impressed between interspaces 3, steep; striae impressed, the punctures small and deep; interstriae convex, 1 with a row of fine punctures, 2 and 3 almost impunctuate and with row of interstrial bristles arising from mesal margin. Vestiture mostly confined to declivital area, consisting of interstrial rows of long, fine hair and some short, fine, recumbent hair; interstrial bristles absent on interspace 1.

Male.— Similar to female except frontal elevation reduced to a broad medially impressed callus the upper margin of which is ornamented by a straight row of reddish bristles; frontal impression longer and with a pair of rounded calluses.

Type Locality.— Volcan Poas, Heredia Prov., Costa Rica.

Host.— An unknown woody vine.

Type Material.— The female holotype, male allotype, and 29 paratypes were collected at the type locality on July 14, 1963, at an elevation of 2,500 m., by S. L. Wood, from a woody vine less than 0.5 cm. in diameter.

The holotype, allotype and most of the paratypes are in my collection; two paratypes are in the Schedl collection.

Cnesinus perplexus, n. sp.
Fig. 17

This species is allied to *robai* Blackman and *coffeae* Schedl, however it differs in having the declivital striae and interstriae very obscurely punctured. The tuberculate frontal carina of female *robai* is absent; and the declivity is much more shallowly excavated than in *coffeae* (it is as in *robai*).

Male.— Length 2.3 mm. (paratypes 2.0-2.3 mm.), 2.5 times as long as wide; color dark brown, the elytra slightly lighter.

Frons transversely, concavely impressed at level of occular emarginations, convex above, below with a broad epistomal callus, the upper slope of callus ornamented by a broad, dense brush of erect, rather long, reddish hair, slightly less extensive than in *coffeae;* upper area subreticulate, a few punctures and setae in lateral area; lateral margins below fundus of impression acute; epistoma, except margin, glabrous.

Pronotum 1.06 times as long as wide; sides parallel on more than basal half, broadly rounded in front; anterolateral angles armed by a row of about seven small contiguous asperites; median line narrowly, rather acutely elevated over basal two-thirds; surface coarsely, shallowly punctured, most of punctures confluent; vestiture short, coarse, conspicuous, covering entire surface.

Elytra 1.6 times as long as wide, 1.7 times as long as pronotum; sides straight and parallel to base of declivity, rather broadly rounded behind; striae impressed, the punctures small, largely confluent toward suture, discernible; interstriae twice as wide as striae, the setiferous punctures small, in rows, mostly finely granulate. Declivity steep, convex except flattened in median area; striae 1 narrowly impressed, others weakly, rather indefinitely impressed; interspace 1 weakly elevated, all with a row of fine, subgranulate, setiferous punctures, subreticulate, subshining. Vestiture of long, erect, stout, interstrial bristles from base to apex, and finer, recumbent, rather long strial and interstrial setae; the bristles about as long as distance between rows of bristles.

Female.— Similar to male except frontal callus and brush reduced; and elytral declivity more coarsely punctured.

Type Locality.— San Ignacio de Acosta, San Jose Prov., Costa Rica.

Type Material.— The male holotype, female allotype, and 32 paratypes were collected at the type locality on July 5, 1963, at an elevation of 1,000 m., by S. L. Wood, from twigs of two species of trees one of which was cultivated.

The holotype, allotype, and most of the paratypes are in my collection; one paratype is in the Schedl collection.

Cnesinus squamosus, n. sp.
Fig. 20

This unique species is not closely allied to any known representative of the genus. It differs from all others by the scalelike ground

vestiture on the elytra that is very broad, wider than long posteriorly; by the rather strongly elevated declivital interspaces 1, 5, and 9; by the strongly produced, suturally emarginate elytral apices; and by the sculpture of the pronotum.

Female.— Length 2.0 mm. (paratypes 1.7-2.1 mm.), 2.5 times as long as wide; color brown.

Frons with a low, crescent-shaped, transverse carina at level half way between antennal bases and upper margins of eyes, convex above, moderately impressed below; tufts of rather long, close, erect reddish hair above epistomal area and at sides below carina largely obscure surface; surface granulose above, with a few short recumbent, yellow scale- and hairlike setae above carina. Eyes separated by at least 2.5 times the width of an eye. Antennal scape with a tuft of long yellow hair.

Pronotum equal in length and width; sides straight and parallel on basal two-thirds, rather abruptly narrowed then broadly rounded in front; surface coarsely, deeply, closely punctured, with rim on side opposite summit slightly elevated; vestiture abundant, covering entire surface, consisting of short scales, each about three or four times as long as wide, stouter posteriorly.

Elytra 1.5 times as long as wide, 1.6 times as long as pronotum; sides straight and parallel to declivital base, posterior profile extended into a broad emarginate process about half as long as wide; striae impressed, the punctures moderately large, mostly obscured by confluence; interstriae slightly less than twice as wide as striae, surface obscured by vestiture but evidently rather coarsely, closely punctured, at least the median row partly granulate. Declivity rather steep, ending below horizontal apical extension; interspaces 1, 2, and 5 reaching apex, 1 moderately, 5 strongly elevated, 3, 4, 6, 7, and 8 somewhat convex and ending near middle (in some paratypes 3 ends in 5), 1 strongly elevated but ending above costal margin at base of flange; costal margin raised from base of declivity to junction with 5, angulately, shallowly emarginate to suture; crests of interspaces evidently finely serrate, obscured by vestiture. Vestiture consisting of interstrial scales of two types; first, median rows of erect bristles about five or six times as long as wide, slightly shorter than distances between rows and separated from one another in the same row by less than their own length; second, broad scales, half as long as bristles, arranged with about one row on each side of row of bristles, anteriorly each slightly longer than wide, posteriorly each slightly wider than long.

Male.— Similar to female except frontal carina and tufts of reddish hair absent, frontal impression greatly reduced, tuft of hair on scape reduced, and elytral sculpture evidently coarser.

Type Locality.— Lower Rio Tempisque, Guanacaste Prov., Costa Rica.

Type Material.— The female holotype, male allotype, and 10 paratypes were collected at the type locality on March 25, 1964, at an elevation of about 15 m., by S. L. Wood, from an unknown cut vine less than 0.5 cm. in diameter. Two additional male paratypes

are labeled: Paraiso, Canal Zone, Panama, March 5 and May 1, 1911, E. A. Schwarz.

The holotype, allotype, and most of the paratypes are in my collection, others are in the U. S. National Museum; one paratype is in the Schedl collection.

Cnesinus frontalis, n. sp.

Fig. 21

This species is unique among known species in the much greater development of the female frontal carina; it is much longer, more angled, higher laterally but lower medially than in other species; both sexes lack specialized frontal vestiture. Other relationships are noted in the key.

Female.— Length 2.2 mm. (paratypes 2.0-2.3 mm.), 2.4 times as long as wide; color almost black.

Frons rather shallowly impressed at level of occular emargination, convex above, below with a very strongly elevated, subangulate carina occupying median two-thirds, its lateral angles highest; short area below carina somewhat flattened with median area distinctly raised; surface above carina reticulate; vestiture sparse, inconspicuous.

Pronotum 1.1 times as long as wide; sides straight on basal two-thirds, very slightly wider in front of middle, rather broadly rounded in front; surface rather coarsely, rather deeply punctured, each puncture about twice as long as wide, seldom confluent; vestiture hairlike, inconspicuous, except in front and at sides.

Elytra 1.4 times as long as wide, 1.4 times as long as pronotum; sides straight and parallel to declivital base, rather broadly rounded behind; striae very weakly impressed, the punctures rather large, moderately deep, close; interstriae about twice as wide as striae, almost flat, the punctures fine, deep, abundant, confused. Declivity steep, convex, somewhat flattened in median area; striae 1 slightly impressed, others not impressed, the punctures small, deep; interstriae 1 slightly elevated, 3 very slightly convex, all armed by rows of rather large, rounded granules. Vestiture largely restricted to declivity, consisting of moderately long, interstrial rows of bristles and short more abundant similar bristles, the longer ones about equal in length to distance between rows.

Male.— Similar to female except frontal carina absent, a broad, transverse, epistomal callus present with a scanty brush of erect hair on its upper margin; a pair of small rounded calluses in frontal impression.

Type Locality.— Puerto Viejo, Heredia Prov., Costa Rica.

Type Material.— The female holotype, and 20 paratypes were collected at the type locality on March 12, 1964, at an elevation of about 70 m., by S. L. Wood, from an unknown vine. The male allotype and 15 paratypes bear similar data but were taken at Peralta, Cartago Prov., Costa Rica, on March 10, 1964.

The holotype, allotype and most of the paratypes are in my collection; two paratypes are in the Schedl collection.

Cnesinus minitropis, n. sp.
Fig. 25

Among described species this one probably is most closely allied to *adustus* Schedl. It differs by the larger size and very short female carina.

Female.— Length 3.1 mm. (paratypes 3.1-3.2 mm.), 2.5 times as long as wide; color very dark brown, the elytra slightly lighter.

Frons flattened on lower half, convex above, a short, transverse carina occupying less than median third; epistoma ornamented by a dense brush of long, erect, reddish bristles; surface of upper area minutely, transversely strigose, punctured above upper level of eyes; vestiture limited to epistoma and sides, setae in lateral area very long, coarse, and rather abundant near eyes. Eyes separated by less than 1.1 times the width of an eye.

Pronotum 1.03 times as long as wide; sides almost straight on basal two-thirds, widest in front of middle, rather broadly rounded in front; surface rather coarsely, longitudinally strigose, the narrow, impunctate, median line slightly elevated; vestiture mostly of fine, short, inconspicuous hair, with some scalelike setae at base and on anterior third.

Elytra 1.6 times as long as wide, 1.7 times as long as pronotum; sides straight and parallel to base of declivity, rather broadly rounded behind; striae impressed, the punctures partly confluent, but usually distinct; interstriae about twice as wide as striae, weakly convex, surface irregular, the punctures fine, abundant, confused. Declivity steep, with margins rounded, flattened on median area between interspaces 3; striae 1 slightly impressed; interspace 1 slightly elevated, the punctures rather small, deep; interstriae with median rows of small, setiferous rounded granules. Vestiture consisting of interstrial rows of erect, stout bristles separated in rows and between rows by distances equal to length of a bristle, and more abundant, narrow scales about half as long as bristles, each scale about four times as long as wide.

Male.—Similar to female except frontal area concavely impressed over broad area, vestiture very slightly shorter.

Type Locality.— San Ignacia de Acosta, San Jose Prov., Costa Rica.

Type Material.— The female holotype, male allotype, and 5 paratypes were collected at the type locality on July 5, 1963, at an elevation of 1,000 m., by S. L. Wood, from pith tunnels in twigs of a cultivated tree.

The holotype, allotype, and paratypes are in my collection.

Cnesinus degener, n. sp.
Fig. 11

This species is intermediate between *bicornus* Wood and the more closely related *elegantis* Wood, but it is much smaller and has more abundant, coarse, discal vestiture on the elytra.

Female.— Length 2.1 mm. (paratypes 2.0-2.3 mm.), 2.4 times as long as wide; color dark reddish brown.

Frons as in *elegantis* except impression slightly deeper, and more feebly convex, almost flat, to well above upper level of eyes; details of sculpture, epistomal tubercles, and vestiture as in *elegantis*.

Pronotum 1.03 times as long as wide; as in *elegantis* except sculpture slightly coarser and with fine, sparse, hairlike setae over entire surface.

Elytra 1.4 times as long as wide, 1.5 times as long as pronotum; sides almost straight and subparallel on basal two-thirds, rather broadly rounded behind, declivity occupying almost posterior half; basal crenulations distinctly formed on median third, becoming a continuous, acute costa laterally; striae slightly impressed, the punctures larger than in *elegantis*, distinctly impressed, subconfluent on 1; interstriae less than twice as wide as striae, irregular, the punctures moderately large, rather abundant, confused, an indefinite median row on each finely granulate. Declivity more gradual than related species, convex, with impression between third interspaces not as deep as in *elegantis;* striae not impressed, the punctures rather small, deep; interstriae 1 abruptly, rather weakly elevated, 3 slightly, broadly elevated, 2 and 3 each armed by a median row of fine granules. Vestiture, rather abundant on disc and declivity, consisting of interstrial rows of erect, very stout bristles, each very slightly longer than distances between bristles within rows and between rows, and more abundant, semirecumbent, fine to very stout strial and interstrial ground setae, each about a third as long as the erect bristles.

Male.— Similar to female except frontal impression not quite as deep, the epistomal tubercles absent.

Type Locality.— Eleven km. north of Matías Romero, Oaxaca, Mexico.

Hosts.— *Serjania* sp. (paratypes) and an unidentified woody vine (type).

Type Material.— The female holotype, male allotype, and five paratypes were collected at the type locality on June 24, 1967, elevation near 200 m., No. 95, in woody vine; 3 paratypes were taken 29 km. north of Matías Romero, Oaxaca, Mexico, on June 29, 1967, elevation 140 m., No. 121, in a cut *Serjania* vine; all taken by me.

The holotype, allotype, and paratypes are in my collection.

Cnesinus atavus, n. sp.

Among known forms this species evidently is more closely allied to *annectens* Wood than to any other, but the relationship is not close. From *annectens* it is distinguished by the presence of an epistomal callus in both sexes, with numerous ornamental frontal setae in the male, by the less extensive frontal impression, by the more coarsely strigose pronotum, and by the more strongly impressed declivital striae.

MALE.— Length 2.2 mm. (paratypes 2.2-2.4 mm.), 2.4 times as long as wide; color dark brown.

Frons transversely impressed at level of ocular emargination, convex above, flattened below that level; epistomal callus rather high, transversely, narrowly carinate on slightly more than median half, its upper slope bearing a large patch of long, reddish, ornamental bristles; surface of convex area to just above upper level of eyes minutely, transversely etched, granulate above; vestiture, in addition to ornamental brush, confined to sides, not conspicuous; eyes rather widely separated.

Pronotum 0.97 times as long as wide, widest just in front of middle, sides feebly arcuate on basal half, rather broadly rounded in front; surface shining, coarsely, longitudinally strigose, the grooves somewhat irregular but punctures not indicated. Vestiture short, fine, mostly abraded in central area, coarser and more conspicuous on margins.

Elytra 1.5 times as long as wide, 1.7 times as long as pronotum sides almost straight and parallel on basal two-thirds to base of declivity, somewhat narrowly rounded behind; basal margins armed by rather well developed, overlapping crenulations, an indefinite row of smaller, submarginal crenulations also present; striae impressed, the small punctures indicated but largely confleunt; interstriae almost twice as wide as striae, closely marked by small, confused, subgranulate punctures. Declivity moderately steep, convex, except very shallowly impressed between third interspaces; striae impressed, perhaps wider than on disc, the punctures obscure; interstriae rather narrowly convex on upper half, the convexity greatly reduced below, the surface irregular, subgranulate. Vestiture abundant, stout, short, with median interstrial rows of erect bristles slightly longer, each bristle a little shorter than distance between rows.

FEMALE.— Similar to male except epistomal callus very slightly smaller, the ornamental bristles replaced by less abundant, less definite, coarse hair.

TYPE LOCALITY.— Three km. south Rinconada, Veracruz, Mexico.

TYPE MATERIAL.— The male holotype, female allotype, and 20 paratypes were collected at the type locality on July 6, 1967, at an elevation of 270 m., No. 170, in a large, dry, herbaceous plant characterized by a strong, distinctive odor, by S. L. Wood.

The holotype, allotype, and paratypes are in my collection.

Cnesinus denotatus, n. sp.

This species evidently is more closely allied to *frontalis* Wood than to other known species but it is easily distinguished by the smaller size, by the more finely punctured pronotum, and by the much narrower, higher female frontal carina.

FEMALE.— Length 1.8 mm. (allotype 1.9 mm.), 2.4 times as long as wide; color dark reddish brown.

Frons rather strongly impressed at level of occular emargination, convex above, flattened below this level, with a very strongly elevated, transverse carina at level of antennal insertion, its transverse length equal to about one-fourth the distance between eyes, almost as high as wide; surface minutely reticulate-granulate; vestiture reduced, short, largely confined to lateral areas.

Pronotum 1.07 times as long as wide; sides straight and almost parallel on basal two-thirds, very slightly wider in front of middle, rather broadly rounded in front; surface shining, very closely, rather finely punctured, the punctures slightly longer than wide, mostly longitudinally confluent. Vestiture mostly on marginal areas, short, stout.

Elytra 1.4 times as long as wide, 1.5 times as long as pronotum; sides almost straight and parallel on basal two-thirds to declivital base, then rather narrowly rounded behind; crenulations on basal margins indistinct, marked by rather large, submarginal punctures; striae impressed, the punctures moderately large, partly confluent; interstriae wider than striae, subshining, the punctures fine, abundant, confused. Declivity moderately steep, convex except impressed between third interspaces; striae 1 moderately, other not impressed; interstriae 1 feebly raised, 2 weakly impressed, 3 higher but feebly convex, each with a row of setiferous granules. Ground vestiture rather abundant, stout, hairlike on disc, scalelike, almost as wide as long on declivity; rows of interstrial bristles erect, each bristle stout, very slightly longer than distance between bristles within a row or between rows.

Male.— Similar to female except frontal carina absent, a weak, shining, epistomal callus present; declivital bristles very slightly flattened.

Type Locality.— Barro Colorado Island, Canal Zone, Panama.

Type Material.— The female holotype was collected at the type locality on December 27, 1963, elevation 70 m., No. 341, at blacklight. The male allotype was taken at Santa Ana, San José, Costa Rica, on October 4, 1963, elevation 1000 m., No. 219, in an *Oreopanax capitatus* twig 5 mm. in diameter; both by S. L. Wood.

The holotype and allotype are in my collection.

Cnesinus atrodeclivis, n. sp.

Fig. 23

This species is rather closely related to *minax* Schedl, but it is easily distinguished by the smaller size, by the coarser, shorter vestiture, by the more strongly impressed declivital striae, and by the more extensively flattened female frons.

Female.— Length 2.2 mm. (paratypes 2.0-2.3 mm.), 2.5 times as long as wide; color dark reddish brown, declivity much darker.

Frons transversely impressed at level of antennal insertion, flattened above this level to upper level of eyes, except weakly, transversely convex between the eyes; armed at level of occular emargi-

nation by a minute, crescent-shaped, transverse carina, its transverse length about equal to one-sixth distance between eyes; epistomal callus weakly developed, its upper slope ornamented by a rather large patch of reddish ornamental bristles; surface rather coarsely reticulate on median third, broad lateral areas above carina ornamenter by rather numerous, very long, stout, yellow hair.

Pronotum 1.06 times as long as wide; shape, sculpture, and vestiture as in *denotatus* (above) except surface more nearly strigose, the punctures virtually obsolete.

Elytra 1.5 times as long as wide, 1.6 times as long as pronotum; sides almost straight and parallel on basal two-thirds to declivital base, rather narrowly rounded behind, basal crenulations very low, poorly formed, interspaces 2-4 bearing several submarginal, indistinct crenulations; striae impressed, the punctures moderately large, mostly confluent on 1 and 2; interstriae wider than striae, the punctures fine, numerous, confused, subgranulate. Declivity steep, convex except slightly flattened toward suture; striae impressed, the punctures not reduced, largely confluent; interstriae convex, each with a median row of setiferous punctures. Vestiture rather abundant, stout; ground vestiture more than half as long as bristles in interstrial rows on disc; ground vestiture and bristles merge on declivity to form closely set, almost uniseriate rows of short bristles.

Male.— Similar to female except frontal impression extending to level of occular emargination, convex above this level, impressed area subconcave; frontal carina absent, its ornamental bristles reduced to a single, transverse row.

Type Locality.— Zamorano, Morazan, Honduras.

Host.— *Valeriana scandens*.

Type Material.— The female holotype, male allotype and five paratypes were collected at the type locality, from the above host, on April 18, 1964, at an elevation of 700 m., No. 548, by S. L. Wood.

The holotype, allotype, and paratypes are in my collection.

Bothrosternus definitus, n. sp.

This species is rather closely related to a specimen tentatively identified from the description as *cancellatus* Chapuis. This species, however, differs in the very different frons that bears a transverse frontal carina, and in details of sculpture of pronotum and elytra.

Female.— Length 3.0 mm. (paratypes 2.95-3.05 mm.), 1.9 times as long as wide; color black.

Frons convex above bases, flattened and transversely impressed below, with a fine, sharply raised carina occupying median three-fourths at level of antennal bases; closely punctured and finely, closely pubescent from carina to epistomal margin and on an area of similar size above carina; median two-thirds from pubescent area to vertex polished, marked only by minutely etched transverse lines; sides and above rugose-reticulate with shallow, indefinite punctures and short, sparse hair.

Pronotum 0.8 times as long as wide; widest behind middle, sides very strongly arcuate and strongly constricted before anterior margin, basal margin bisinuate and extending into scutellar notch; surface dull, closely, shallowly, coarsely punctured, the punctures elliptically elongate, some twice as long as wide; glabrous.

Elytra 1.2 times as long as wide; sides almost straight and parallel on slightly more than basal half, rather broadly rounded behind; striae strongly, rather sharply impressed, the punctures almost obsolete; interstriae wider than striae on disc, moderately convex on basal half, becoming narrowly carinate behind and on declivity, the punctures on basal half disc small, shallow, confused, obscure. Declivity rather steep, convex; interstriae very narrowly carinate on upper third, becoming finely beaded below; striae rugose-reticulate, the punctures obscure, much wider than interstriae.

Male.— Similar to female except frontal carina and most of frontal pubescence absent; convex area of frons with a more definite summit just above level of antennal insertion.

Type Locality.— Finca Gromaco on Rio Coto Brus, Puntarenas Prov., Costa Rica.

Type Material.— The female holotype, male allotype and 49 paratypes were collected at the type locality on July 14, 1963, at an elevation of about 500 m., by S. L. Wood, from the central axis of a subtriangular, woody vine less than 1 cm. in diameter. Six paratypes were taken at Peralta, Cartago Prov., at 500 m., by S. L. Wood, from a different woody vine; one paratype is labeled "Panama."

The holotype, allotype and most of the paratypes are in my collection, 2 paratypes are in the Schedl collection.

Biology.— The habits are much the same as *foveatus*, except that mature larvae, pupae and young adults always are arranged in their cells with the oldest nearest the entrance tunnel; they decrease in age consecutively as the distance from the entrance hole increases. In more than 30 tunnels examined of varying stages of completeness one mature female beetle was found in each; there were a few males in the mature brood. A loose, fluffy, white fungal mycelium was conspicuous in all but the newest tunnels.

NOTE

GROUND NESTING OF THE FERRUGINOUS HAWK IN WEST-CENTRAL UTAH

On 8 April 1967 a ground nest of the Ferruginous Hawk (*Buteo regalis*) was found 9.6 miles south of Fairfield, Utah County, Utah. It had been constructed atop the 30 cm. high roadbank of a well-traveled, improved gravel road. The nest itself was 25 cm. thick, giving it a total height of 55 cm. above the valley floor. The surrounding area is essentially a level plain at 1640 m. elevation surrounded by mountains ranging up to 2433 m. in elevation. Vegetation in the immediate vicinity of the nest was sparse, and consisted mainly of Russian thistle (*Salsola kali*).

When first observed, the female hawk protested vocally and assumed a defense posture with wings spread and body feathers erect. She remained in this position as our vehicle passed within 5 m. of the nest. The female remained at the nest until we walked to within 15 m. of her. She then flew a short distance away, realighted on the ground, and continued screaming. Throughout our visit her mate remained perched on a telephone pole several hundred meters from the nest site.

The nest containd two eggs and was composed of a horsebrush (*Tetradymia glabrata*) and Russian thistle (*Salsola kali*) base with an Indian ricegrass (*Oryzopsis hymenoides*) lining. A 40 cm. section or rope, a large scrap of paper, and several pieces of dried manure had also been incorporated into the nest.

Bent (Bull. U. S. Natl. Mus. 167:286,1937) and Peterson (A Field Guide to Western Birds, p. 71, 1961) state that the Ferruginous Hawk prefers to nest in trees where trees are available but may also nest on hillsides, cutbanks, buttes, cliffs, or rocky pinnacles. A study presently being conducted by the senior author concerning the nesting ecology of the Ferruginous Hawk in Utah has revealed several active nests and numerous potential nest sites on terrain described as typical by Bent and Peterson (*op. cit.*). Instead of using one of these more typical sites, this pair chose to nest upon the level valley floor beside a well-traveled road. To our knowledge, this is the first recorded Ferruginous Hawk nest located on essentially level terrain.

When we visited the nest again on 16 April 1967 we found that the female hawk has been shot and killed at the nest site. Both of her legs and 5 left rectrices had been removed. Helpmate was not seen. The female specimen measured 65 cm. in length and had a wingspread of 151 cm. (unstretched) which is 9 cm. in excess of the maximum wingspread of this species as indicated by Peterson (*op. cit.*).

Appreciation is extended to Dr. J. R. Murphy for assistance in the course of our studies.—J. Bradford Weston and David H. Ellis, Department of Zoology and Entomology, Brigham Young University, Provo, Utah 84601.

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UNDESCRIBED SPECIES OF NEARCTIC TIPULIDAE (DIPTERA), IX

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The novelties considered herewith are chiefly from Alaska and the Canadian Northwest, a few from Oregon and Washington, and a small series from the Ozark Mountains, Missouri. The specimens were captured by the writer and by various friends who are named in the text under the different species. Except where indicated to the contrary the types of the new forms are preserved in the author's personal collection of these flies.

Limoniini

Limonia (*Dicranomyia*) *acinomeca*, n.sp.

Allied to *gladiator* and *omissinerva;* general coloration of thorax yellow, praescutum and scutal lobes blackened, pleura patterned with dark brown; rostrum yellow; wings subhyaline, stigma pale; male hypopygium with tergal lobes conspicuous, rostral spines far distal in position, very long and slender, only narrowly separated; mesal-apical lobe of gonapophysis very slender, smooth, gently curved.

Male.— Length about 5.5-6 mm.; wing 5.5-6.5 mm.

Female.— Length about 6.5 mm.; wing 7 mm.

Rostrum yellow; basal segment of palpus yellow, remainder dark brown. Antennae with scape obscure yellow, apex and remainder of organ black; proximal flagellar segments oval, outer ones more elongate, especially the terminal segment which is stout and about one-half longer than the penultimate; verticils conspicuous. Head brownish gray, paler beneath; anterior vertex broad.

Pronotal scutum dark brown, sides yellowed, scutellum yellow. Mesonotal praescutum yellow laterally, disk with three nearly confluent blackened stripes, the lateral pair crossing the suture to include the scutal lobes; central region and posterior callosities of scutum yellowed; scutellum light brown, narrowly paler medially, parascutella yellow; mediotergite dark brown, the narrow lateral borders and the pleurotergite yellow. Pleura yellow, anepisternum and

1 Amherst, Massachusetts.

especially the sternopleurite conspicuously darkened. Halteres with stem yellow, knob infuscated. Legs with coxae and trochanters yellow; remainder brownish yellow, tips of femora and tibiae vaguely darker, outer tarsal segments dark brown. Wings subhyaline, prearcular field light yellow; stigma very pale, scarcely differentiated from the ground; veins light brown, prearcular veins and Sc more yellowed. Venation: Sc_1 ending opposite origin of *Rs*, Sc_2 far retracted, Sc_1 alone nearly equal to *Rs;* cell M_2 open by atrophy of *m*, *m-cu* shortly beyond fork of *M*.

Abdominal tergites dark brown, basal sternites paler, genitalia yellow; hypovalvae of ovipositor blackened basally. Male hypopygium with tergite transverse, narrowed outwardly, posterior border with a broad U-shaped emargination to form conspicuous lobes that bear numerous relatively short pale setae; marginal thickening including the lobes. Basistyle with ventromesal lobe small. Dorsal dististyle a curved sickle, narrowed outwardly into a slender point; ventral style subequal in area or slightly smaller than the basistyle, narrowed into a moderately stout prolongation, the two spines nearly straight, very long, especially the outer which is fully twice the prolongation; spines separated by a distance only slightly greater than their basal puncture. Gonapophysis with mesal-apical lobe very slender, smooth, curved gently to the subacute tip. Aedeagus slender, the obtuse apex simple.

Habitat.— Alaska.

Holotype, ♂, Taylor Highway, Mile 49, along west fork of Dennison River, August 13, 1954 (C. P. Alexander). Allotopotype, ♀, pinned with type. Paratopotypes, ♂♂, August 13-15, 1954.

Among the Nearctic species the present fly is most like *Limonia* (*Dicranomyia*) *gladiator* (Osten Sacken), differing in the extensive brownish black coloration of the thoracic notum and especially in the very different hypopygium, including the rostral spines. The European *L.* (*D.*) *omissinerva* (de Meijere) (Tijds. Ent., 61:129, 1918; 62:83-84, fig. 16- ♂ hypopygium; 1919) is more closely allied, differing from de Meijere's descriptions in the conspicuous dark pattern of the thoracic pleura and in the details of the male hypopygium, including the conspicuous tergal lobes and the longer rostral spines, as described.

Limonia (*Dicranomyia*) *apiceglabra*, n.sp.

Allied to *mitis;* general coloration of thoracic dorsum brownish gray, praescutum darker medially, pleura light gray; femora brownish yellow, tips brown; wings whitened, very restrictedly patterned with pale brown, Sc_1 long, subequal to *Rs*; male hypopygium with tergal lobes conspicuous, their apices rounded, broadly glabrous; dorsal dististyle a gently curved sickle that narrows gradually to the slender apex; ventral style subequal in area to the basistyle, rostral prolongation slender, the two spines placed close together near apex.

Male.— Length about 5.5-6 mm.; wing 6-6.8 mm.; antenna about 1.1-1.2 mm.

Rostrum and palpi dark brown. Antennae dark brown; flagellar segments short-oval with short verticils, terminal segment about one-half longer than the penultimate. Head brown.

Pronotum brownish gray, scutellum more yellowed. Mesonotal praescutum gray laterally, disk with three confluent brown stripes, the median one darker brown; posterior sclerites of notum gray, scutal lobes darker. Pleura light gray, dorsopleural region and metapleura light yellow. Halteres with stem pale yellow, knob infuscated. Legs with coxae and trochanters yellow; femora brownish yellow, tips brown, tibiae similar, the tips more narrowly darkened; basitarsi brownish yellow, outer segments dark brown. Wings whitened, very restrictedly patterned with pale brown, including the stigma; narrower to scarcely indicated darkenings at origin of *Rs*, cord, outer end of cell *1st* M_2 and along vein *Cu*, the areas indicated chiefly by the darkened veins; prearcular and costal fields more yellowed, including the veins. Venation: Sc_1 ending opposite or shortly before origin of *Rs*, Sc_2 far retracted, Sc_1 alone nearly equal to *Rs;* cell *1st* M_2 subequal to or slightly longer than vein M_3; *m-cu* before fork of *M*.

Abdomen brown, including the hypopygium. Male hypopygium with posterior border or tergite deeply emarginate, lateral lobes large, their setae subterminal, there being a broad glabrous outer portion. Basistyle and ventral dististyle subequal in area, the ventromesal lobe oval, relatively small. Dorsal dististyle a strongly curved sickle, broad at base, narrowed gradually to the slender apex; ventral style oval, the rostral prolongation slender, the two straight spines placed close together shortly before the obtuse apex; spines slightly unequal, the shorter one about twice as long as the apex of prolongation beyond its insertion. Gonapophysis with mesal-apical lobe slender, very slightly curved.

HABITAT.— Alaska, Yukon.

HOLOTYPE, ♂. Alaska Highway at Mile 1152, Yukon, along Lake Creek, July 7, 1952 (C. P. Alexander). PARATYPE, ♂. Teklanika River, McKinley National Park, Alaska, July 15, 1952 (D. L. Carson).

The most similar species include the European *Limonia* (*Dicranomyia*) *mitis* (Meigen) and *L.* (*D.*) *zernyi* (Lackschewitz) which differ in hypopygial structure. The latter species is known to me from the original description and figure by Lackschewitz (Naturh. Mus. Wien, Ann. 42:217, pl. 6, fig. 14 (♂ hypopygium): 1928). This shows the tergite deeply emarginate but with the apices of the lobes setiferous and with the rostral prolongation of the ventral dististyle and its spines quite different.

Limonia (*Dicranomyia*) *chillcotti*, n.sp.

General coloration gray, praescutum with a brown central stripe, lateral areas obsolete; antennae brownish black, flagellar segments subglobular; wings whitened, very restrictedly darkened, especially over cord and outer end of cell *1st* M_2, stigma yellowed; vein Sc_1

long, subequal to *Rs*, *m-cu* shortly before fork of *M;* male hypopygium with posterior border of tergite having a V-shaped emargination, lobes conspicuous, apices without setae; basistyle and ventral dististyle subequal in area; rostral prolongation of ventral style small, with two long straight spines that are longer than the prolongation.

Male.— Length about 5.5 mm.; wing 6 mm.; antenna about 1.0 mm.

Female.— Length about 6-7.5 mm.; wing 6.5-8 mm.

Rostrum brownish gray, darker beneath, mouthparts and palpi conspicuously dark brown. Antennae brownish black throughout; flagellar segments beyond the first subglobular, outer segments passing into short-oval, all segments with very short apical pedicels, verticils shorter than the segments. Head light gray; anterior vertex about twice the diameter of scape.

Pronotal scutum brownish gray, scutellum and pretergites obscure yellow. Mesonotum clear gray, praescutum with a brown central stripe that is darker anteriorly, lateral stripes obsolete; posterior sclerites brownish gray, central area of scutum clear light gray. Pleura light gray. Halteres with stem pale yellow, knob brown. Legs with fore and middle coxae yellowish brown, posterior pair clearer yellow; trochanters yellow; femora brownish yellow, clearer yellow basally, tips narrowly dark brown; tibiae and tarsi brown. Wings whitened, especially the milky base, with a very restricted darkened pattern that chiefly is evident by the darkened veins, including the cord and outer end of cell *1st* M_2 and less evidently the origin of *Rs* and R_2, vein *Cu* similarly darkened; stigma pale yellow to very pale brownish yellow, scarcely darker than the ground; veins brown. Venation: Sc_1 ending opposite origin of *Rs*, Sc_2 far retracted. Sc_1 about equal in length to *Rs*, the latter in cases angulated and weakly spurred near origin; *m-cu* shortly before fork of *M*.

Abdominal tergites dark brown, proximal sternites paler brown. Ovipositor with genital segment and valves fulvous; cerci very slender, upcurved to the acute tips, hypovalvae long and powerful, nearly straight. Male hypopygium with tergite slightly narrowed outwardly, posterior margin with a deep V-shaped notch, lobes conspicuous, each with about 20 long setae on base and central part, lacking on the broad ends. Ninth sternite a small transversely oval plate with relatively few setae. Basistyle and ventral dististyle subequal in area. Dorsal dististyle a strong curved sickle that narrows gradually to an acute point; ventral style with setae relatively short; rostral prolongation small, with two slightly separated long straight spines that are longer than the prolongation and about five times as long as the latter beyond the point of origin of the outer spine. Gonapophysis with mesal-apical lobe slender, slightly curved. Aedeagus terminating in a single compressed lobe.

Habitat.— Manitoba.

Holotype, ♂, Farnworth Lake, near Churchill, June 26, 1952 (J. G. T. Chillcott); Canadian National Collection. Allotopotype.

♀, with the type. PARATOPOTYPES. 2 ♀ ♀. June 26-28, 1952. Ecological data. Nos. F-B, F-C, F.D. 18.

The species is named for the collector, the late Dr. J. G. T. Chillcott, of the Entomology Division, Ottawa, Canada, authority on the Nearctic Empididae and related families. Dr. Chillcott died unexpectedly in Nepal on April 20, 1967, at the early age of 37, while engaged in collecting Himalayan insects. In its general appearance the species is most like *Limonia* (*Dicranomyia*) *liberta* (Osten Sacken), *L.* (*D.*) *halterata* (Osten Sacken), and similar dark colored species, differing evidently in the pattern and venation of the wings and in hypopygial structure.

Limonia (*Dicranomyia*) *involuta*, n.sp.

General coloration gray, pronotum and praescutum more darkened medially; antennae black; wings narrow, yellowed, stigma scarcely indicated; ovipositor with cerci unusually short and stout; male hypopygium complex in structure, including the basistyle and ventral dististyle, the latter divided into two unequal lobes; rostral spines separate, the outer placed on a small basal tubercle; gonapophysis with mesal-apical lobe long and slender, curved near outer end.

MALE.— Length about 6-6.5 mm.; wing 5.2-6 mm.

FEMALE.— Length about 5.5-6.2 mm.; wing 5.5-6.5 mm.

Rostrum yellowish brown; palpi black. Antennae black; proximal flagellar segments beyond the first short, gradually passing into oval. Head gray; anterior vertex broad, more yellowish gray.

Pronotum blackened medially, sides brownish gray. Mesonotum brownish gray, praescutum with a central darker stripe, scutellum more yellow pollinose. Pleura gray pruinose, dorsopleural region brownish yellow. Halteres yellowed. Legs with coxae and trochanters yellow; remainder of legs light brown, femoral bases slightly more yellowed. Wings narrow, yellow, prearcular and costal fields more saturated yellow, stigma scarcely indicated; veins light brown, more yellowed in brightened fields. Venation: *Sc* short. Sc_1 ending opposite to just beyond origin of *Rs*, Sc_2 only slightly removed from tip; *m-cu* shortly before fork of *M*, in cases to about two-thirds its length.

Abdomen stout, brownish gray, hypopygium more fulvous brown. Ovipositor with cerci unusually short and stout, gently upcurved to the acute apex, hypovalvae elongate, terminating opposite ends of cerci. Male hypopygium with tergite transverse, posterior border shallowly emarginate to form low lobes with relatively few long yellow setae. Basistyle with ventromesal lobe very large and modified, including a more posterior arm from its base, slightly expanded to weakly bilobed at apex, provided with long coarse setae; body of lobe on outer margin with a stout appendage that narrows farther into a slender arm with blackened setae, at base of latter the lobe with five or six spinoid setae; mesal face of basistyle at apex with a small slender lobe, its apex with several long setae. Dorsal

dististyle a strong rod, outer end curved and narrowed into a straight spine; ventral style with body pale, on outer margin at base with a small accessory lobule, near apex with a group of delicate yellow setae; body of style oval, its area much less than that of the basistyle; rostral prolongation unique, stout and more sclerotized, beak with several setae; outer margin with two spines, the outer placed on side of a small tubercle. Gonapophysis with mesal-apical lobe long and slender, curved near outer end.

HABITAT.— Canadian Northwest Territories and Yukon.

HOLOTYPE. ♂. Good Hope, Mackenzie River, Northwest Territory, August 22, 1929 (Owen Bryant); Lot 75. ALLOTOPOTYPE, ♀, with type. PARATOPOTYPES, several ♂ ♀; PARATYPES, 3♂ ♂, 7♀ ♀, Gravel Lake, 58 miles east of Dawson, Yukon, altitude 2,050 feet, August 10, 1962 (P. J. Skitsko and R. E. Leech); Canadian National Collection; some specimens labelled 'ex *Carex*'.

Limonia (*Dicranomyia*) *involuta* is still another of the numerous Holarctic members of the subgenus that have the male hypopygium very complicated in structure. It is readily told from other species by the small yellow wings and the details of structure of the male hypopygium, particularly the unequally bilobed ventral dististyle, the rostral prolongation, and the conformation of the lobes of the basistyle. As is the case with many others in this category the species is adult late in the season. Other somewhat similar but not closely related species include *L.* (*D.*) *intricata* Alexander and *L.* (*D.*) *melleicauda* (Alexander).

Limonia (*Dicranomyia*) *ozarkensis*, n.sp.

Size medium (wing about 6.5 mm.); mesothorax chiefly dark brown, restrictedly patterned with obscure yellow; rostrum obscure yellow; antennae brownish black; legs obscure yellow; wings faintly grayish yellow, stigma pale brown. Sc_1 ending opposite to shortly beyond origin of *Rs;* male hypopygium with posterior border of tergite convexly rounded, with a small median emargination; dorsal dististyle a strongly curved slender hook, ventral style having rostral prolongation with two long straight black spines; mesal-apical lobe of gonapophysis black, flattened, narrowed to a small apical point.

MALE.— Length about 6.5-7 mm.; wing 6.8-7 mm.; antenna about 1.5 mm.

FEMALE.— Length about 6.5-7 mm.; wing 7.5-8 mm.

Rostrum and mouthparts obscure yellow; palpi dark brown. Antennae brownish black, in cases with scape obscure yellow; flagellar segments oval. Head dark brown; anterior vertex about twice the diameter of scape.

Pronotal scutum brown, the borders and the scutellum yellowed. Mesonotal praescutum almost covered by three confluent dark brown sparsely pruinose stripes, humeral region and narrow lateral margins brownish yellow; scutal lobes dark brown, central area and scutellum obscure yellow; mediotergite brownish gray, pleurotergite

more brownish yellow. Pleura chiefly dark brown, sparsely pruinose, posterior sclerites paler, in cases less distinctly infuscated. Halteres with stem yellow, the small knob dark brown. Legs with coxae yellowed, fore pair darkened basally; trochanters yellow; remainder of legs obscure yellow to brownish yellow, outer segments infuscated. Wings faintly grayish yellow, prearcular and costal regions clearer yellow, stimga pale brown; veins brown. Macrotrichia on longitudinal veins beyond general level of origin of *Rs*, on Anals only at extreme outer ends. Venation: Sc_1 ending opposite or shortly beyond origin of *Rs*, Sc_2 slightly removed, Sc_1 alone subequal to R_2; *m-cu* at or close to fork of *M;* inner end of cell *1st* M_2 not arcuated.

Abdomen dark brown, basal sternites more yellowed. Male hypopygium with tergite large, posterior border convexly rounded, with a shallow median emargination, the thickened borders narrow. Basistyle in area nearly twice the ventral dististyle, ventromesal lobe relatively small. Dorsal dististyle a slender strongly curved hook, narrowed to a spine; ventral style small, the prolongation narrowed into a beak; rostral spines two, black, long and straight, placed close together near base of prolongation, strongly divergent, each spine about one-third to one-half longer than the prolongation beyond it. Gonapophysis with mesal-apical lobe blackened, elongate flattened, narrowed to the small apical point, in cases the lower margin microscopically roughened. Aedeagus relatively slender, outer end decurved.

HABITAT.— Missouri (Ozark Mountains).

HOLOTYPE, ♂. Roaring River State Park, Barry County, May 24, 1942 (C. P. Alexander). ALLOTYPE, ♀. Hazlegreen, Laclede County, May 22, 1942 (C. P. Alexander). PARATOPOTYPES, several of both sexes, on six pins, collected with the holotype, May 23-24, 1942.

Limonia (*Dicranomyia*) *ozarkensis* is quite distinct from other Nearctic species, especially in details of the male hypopygium, particularly the ventral dististyle and gonapophyses. In its general appearance it suggests various western North American species, such as *L.* (*D.*) *libertoides* (Alexander) and *L.* (*D.*) *stigmata* (Doane). By my key to the northeastern American species (Diptera of Connecticut, 1942, pp. 310-312; 1942; reprinted 1966) the fly runs to the quite different *L.* (*D.*) *stulta* (Osten Sacken) with which it was associated in nature.

Limonia (*Geranomyia*) *innoxia*, n.sp.

Rostrum slightly more than one-half the remainder of body; pleura uniformly brownish yellow; femora light brown, tips conspicuously darker brown; wings pale brown, stigma darker; *Sc* long, Sc_1 ending about opposite three-fourths *Rs;* abdominal tergites bicolored, brownish yellow, apices broadly darker brown; male hypopygium with tergal lobes small, widely separated; rostral prolongation of ventral dististyle small, the two spines placed on a single tubercle, one at summit, the second at near two-thirds the length; gonapophysis with mesal-apical lobe long and slender, tip acute.

Male.— Length, excluding rostrum, about 7.0-7.5 mm.; wing 7.5-7.8 mm.; rostrum alone about 4.0-4.2 mm.

Rostrum light brown, slightly more than one-half the remainder of body; maxillary palpi black. Antennae with scape and pedicel brownish black, flagellum black; flagellar segments oval, the more proximal ones more truncated. Anterior vertex restrictedly light gray, remainder of head dark gray.

Pronotum light brown. Mesonotal praescutum with three pale brown stripes, the central one more reddened, lateral and humeral regions yellowed; posterior sclerites of notum dark brown, median region of scutum gray, posterior border of scutellum yellowed. Pleura and pleurotergite uniformly brownish yellow. Halteres with stem brownish yellow, base clearer, knob brown. Legs with coxae yellowed, fore pair darker; trochanters brownish yellow; femora light brown, tips narrowly but conspicuously dark brown; tibiae light brown, tips narrowly darkened; tarsi brownish black, proximal ends of basitarsi slightly paler. Wings very pale brown, stigma oval, darker brown; veins brown. Longitudinal veins beyond general level of origin of *Rs* with macrotrichia. Venation: *Sc* long, Sc_1 ending about opposite three-fourths *Rs*, Sc_2 slightly removed; supernumerary crossvein in cell *Sc* distinct; *m-cu* close to fork of *M*.

Abdominal tergites bicolored, brownish yellow, their apices broadly darker brown; proximal sternites more uniformly brownish yellow, outer segments darker; hypopygium brown. Male hypopygium with tergite transverse, posterior border very shallowly emarginate, the relatively small widely separated lateral lobes provided with numerous black setae. Basistyle with ventromesal lobe large, about one-half the body of style. Dorsal dististyle a strongly curved rod, the tip acute; ventral style large, its area more than three times the basistyle; rostral prolongation small, with two subequal spines, placed on a common basal tubercle, one spine terminal, the second at near two-thirds the length of the tubercle which is subequal in length to the prolongation itself. Gonapophysis with mesal-apical lobe long and slender, tip acute.

Habitat.— Missouri (Ozark Mountains).

Holotype, ♂, Roaring River State Park, Barry County, May 24, 1942 (C. P. Alexander). Paratopotype, ♂, pinned with type.

The most similar regional species include *Limonia* (*Geranomyia*) *canadensis* (Westwood) and allies, all differing from the present fly in hypopygial structure. The bicolored nature of the abdominal tergites of the present fly should be emphasized.

Limonia (*Metalimnobia*) *californica decreta*, n. subsp.

Generally similar to *californica*, differing most evidently in the more restricted darkened wing pattern. Wings with the pale ground extensive, including broad marginal areas in cells R_3 to M_3; darkest areas on anterior half of wing very small, the arcular mark oval, restricted to cell *R*, separated from the area at origin of *Rs* by a distance approximately three times the width of the latter; yellow center

of stigma extensive, the enclosed veins scarcely bordered by brown. Legs with blackened femoral tip subequal to the yellow subterminal ring. Abdomen of type male yellowed, posterior borders of segments brown, becoming more extensive on outer segments, on segment seven including the outer half. Male hypopygium with apical lobe of gonapophysis relatively long and slender, generally parallel-sided, tip obtuse, without setae, with a very small sublateral knob.

MALE.— Length about 15-18 mm.; wing 14.5-23 mm.

FEMALE.— Length about 18 mm.; wing 21 mm.

HABITAT.— Western North America.

HOLOTYPE, ♂, Auke Bay, Juneau, Alaska, July 26, 1952 (William Frohne). ALLOTYPE, ♀, Boyer, Oregon, July 13, 1933 (J. Macnab). PARATYPES, 1 ♂, Wellington, Vancouver Island, British Columbia, June 2, 1957 (Richard Guppy); 1 ♀, Vancouver, British Columbia, August 18, 1931 (H. B. Leech); 1 ♀, Forest Grove, Oregon, April 20, 1918 (F. R. Cole); 1 ♂, Odell Lake, Oregon, August 6, 1948 (K. M. Fender); 1 ♂, Boulder Lake Trail, Olympic National Park, Washington, 3,600 feet, July 19, 1948 (C. P. Alexander); 1 ♂, Washington, without further data.

The various specimens had been placed with typical *Limonia* (*Metalimnobia*) *californica* (Osten Sacken) but evidently should be considered as distinct. In the typical form the major darkened areas in cell *R* of the wings are only slightly smaller than the ground pattern. It may be noted concerning the gonapophyses of the male hypopygium that other Nearctic species have a brush or scattered setae at or near their tips, such being found in *L.* (*M.*) *cinctipes* (Say), *L.* (*M.*) *dietziana* Alexander, *L.* (*M.*) *hudsonica* (Osten Sacken), *L.* (*M.*) *immatura* (Osten Sacken), *L.* (*M.*) *quadrimaculata* (Meigen), and some others.

PEDICIINI

Genus *Pedicia* Latreille

Subgenus *Pentacyphona*, n. subgenus

Differs from the subgenus *Tricyphona* Zetterstedt chiefly in the structure of the male hypopygium, especially the five-parted dististyle.

Antennae 16-segmented; short in most species, longest in *huffae*.

Wings with branches of *Rs* bifurcate, R_{2+3} very long, R_{1+5} shorter; cell *1st* M_2 commonly closed, open in *huffae*.

Male hypopygium with apex of the united basistyle and inner dististyle distinctive, terminating in five unequal fingerlike lobes. Outer dististyle a small oval lobe, provided with conspicuous setae, the longest exceeding the style.

TYPE SPECIES.— *Pedica* (*Pentacyphona*) *ampla* (Doane)— Western Nearctic.

Other included species are *P.* (*P.*) *aspidoptera* (Coquillett) and subspecies *convexa* Alexander; *P.* (*P.*) *autumnalis* (Alexander); *P.* (*P.*) *cinereicolor* Alexander; *P.* (*P.*) *euryptera* Alexander; *P.* (*P.*)

huffae Alexander; *P.* (*P.*) *perangusta* Alexander; *P.* (*P.*) *smithae* Alexander; *P.* (*P.*) *subaptera* (Alexander), with *steensensis* Alexander, synonym; and *P.* (*P.*) *truncata* Alexander.

All species are Nearctic and chiefly from Western North America, only *autumnalis* and *huffae* being from Eastern North America, as far south as Tennessee.

Dicranota (*Dicranota*) *diacantha*, n.sp.

Male.— Length about 5.5 mm.; wing 6 mm.

Characters generally as in *Dicranota* (*Dicranota*) *astigma* Alexander. Wings slightly darker. Macrotrichia of veins more abundant, occurring on all longitudinal veins basad to the arculus, on both Anals numbering approximately 75 to 100 on either vein. Veins in cell R_1 more approximated, the distance between them about three times the length of R_2.

Male hypopygium with posterior border of tergite broadly emarginate, lateral arms slightly basal in position, long and slender, the apex strongly dilated into a suboval head that is produced laterad into a point. Basistyle with apical lobes stout, tips broadly obtuse, inner lobe with abundant stout setae; interbase a stout nearly straight rod, slightly dilated at apex, with two small acute spines, one in alignment with the stem, the terminal point subequal in size, directed strongly laterad. Dististyle unusually long, subequal to the interbase, appearing as a gently curved blade that widens gradually into a long-oval head with sparse setae, the apex obtuse.

Habitat.— Oregon.

Holotype, ♂, on slide, Cloverdale, Tillamook County, July 28, 1950 (Noël Crickmer).

The most similar species are *Dicranota* (*Dicranota*) *astigma* Alexander and *D.* (*D.*) *rainierensis*, n.sp., which are distinguished by the more sparse trichia of the wing veins and by hypopygial structure, especially the interbase and dististyle. In both species the interbase at tip is obtusely rounded, without spinous points as in the present fly.

Dicranota (*Dicranota*) *rainierensis*, n.sp.

Size relatively small (wing of male to 6 mm.); antennae short; wings slightly tinged with gray, stigma very faintly indicated, vein R_2 far distad, cell R_3 sessile, vein R_{4+5} preserved; male hypopygium with posterior border of tergite shallowly concave, the lateral arms some distance basad of the margin to form a narrow U-shaped emargination; interbase with outer end enlarged, oval; dististyle relatively slender, not or only slightly expanded outwardly.

Male.— Length about 4.5-5 mm.; wing 5-6.5 mm.; antenna about 0.7-0.8 mm.

Female.— Length about 6.5 mm.; wing 6.5 mm.

Described from alcoholic material. Rostrum brown, palpi darker. Antennae short, brown; proximal two flagellar segments more or

less united to form a single elongate article, the faint suture at near two-thirds the length, succeeding segments short-oval. Head brown.

Pronotum brown. Mesonotum dark brown medially, sides of praescutum broadly yellow, the lateral praescutal stripes much paler brown; posterior border of scutellum, parascutella and sides of mediotergite paler. Pleura and pleurotergite light brown, sternopleurite darker. Halteres long and slender, stem yellow, the small knob light brown. Legs with coxae and trochanters yellow, darker in female; remainder of legs brown. Wings slightly tinged with gray, stigma very faintly indicated, occupying the area between vein R_2 and the supernumerary crossvein in cell R_1; R_2 far distad, R_{1+2} short, cell R_3 sessile. R_{4+5} preserved, cell *2nd A* relatively narrow.

Abdomen medium to dark brown, hypopygium brownish yellow. Ovipositor with valves horn-yellow, cerci upcurved to the acute tips.

Male hypopygium with posterior border of tergite shallowly emarginate or concave, the relatively short lateral arms some distance basad of the border, forming a narrow U-shaped emargination. Outer lobes of basistyle subequal, the lateral one with delicate setae, inner lobe with setae slightly spinoid; interbase large, at near midlength strongly curved, outer end enlarged oval, tip obtuse. Dististyle relatively slender, not or only slightly expanded outwardly, tip obtuse.

HABITAT.— Washington.

HOLOTYPE, alcoholic ♂. White River, Mount Rainier, Pierce County, July 27, 1966 (Hynes and Wilson). ALLOTOPOTYPE, ♀. PARATOPOTYPES, 3 ♂♂, July 27-28, 1966 (Hynes and Wilson). Hynes Nos. 1.1, 1.3, 1.7 and 1.16, reared. Types in Alexander collection through Dr. C. Dennis Hynes.

Dicranota (*Dicranota*) *rainierensis* is generally similar to *D.* (*D.*) *astigma* Alexander, differing especially in the venation and in hypopygial structure, especially the tergite and interbase.

STUDIES IN NEARCTIC DESERT SAND DUNE ORTHOPTERA

Part XI. A new arenicolous species of *Stenopelmatus* from Coachella Valley with Key and biological notes.

Ernest R. Tinkham*

The discovery of a new Jerusalem Cricket inhabiting a very small segment of the sand and dune areas of Coachella Valley did not come easily. In fact, I had been collecting in Cochella Valley since 1952, and including my National Science Foundation grant years, 1957-1960, before the discovery was made. Part of the credit for the find goes to my Beaumont Class in *Nature Study of the Desert*, an extension course offered by San Diego State College under my instructorship.

It was a night one shouldn't take out a class of teachers. The world was calm at Beaumont when we left before sundown but by the time we arrived at the Palm Springs Depot, 10 miles west of Palm Springs, California, the wind was howling and cold and the sand flying. I asked them if they wished to return to the sanctuary of their homes or face the elements. They were game and chose the latter.

We went south from the depot, crossed some sand dunes, a very broad arroyo bed and a much broader expanse of desert grass (*Oryzopsis hymenoides*) to some larger undulating dunes piled up at the north base of the San Jacinto mountains. There was less wind here and the night was not too unpleasant. The discovery of the first Jerusalem Cricket came as a great surprise. Three specimens were taken that Saturday night in early May, 1962, and all were half-grown and medium in size. They were placed in oatmeal cartons and kept alive and studied for months to learn as much as possible about their biology.

Despite additional nights out on these dunes in the past six years, very few additional specimens have been found.

This paper is a contribution from the National Science Foundation and its publication assisted by a publication grant.

The Key, description and biological notes follow.

Provisional Key to the Stenopelmatine Crickets of California

1. Tibial spines, vestigial or missing on the apical dorsal margins of the caudal tibiae. Ringlet of 6 apical caudal calcars almost even and broadly spathulate for arenicolous habitus. Median or presubapical spur on the ventral surface of the foretibiae absent. Pronotum not expanding anteriorly. Size medium; coloration uniformly orangish .....

*Indio, California.

..... *Ammopelmatus kelsoensis* Tinkham
Tibial spines prominently developed on the apical dorsal margins of the caudal tibiae. Ringlet of 6 apical caudal calcars uneven in length, usually conical or subconical in form, the innermost calcar the longest. Median or pre-subapical spur on the ventral surface of the foretibiae always present except in the new species herein described. Pronotum expanding anterioradly to house the posterior portions of the large head except in the new species herein described. Size medium to very large; coloration often dark to orangish; the abdomen darkest .....
..... *Stenopelmatus* Burmeister (2)

2. Foretibiae bearing only two ventral apical spurs immediately posterioradly of the third and fourth calcars. Caudal tibiae with three dorsal apical or subapical teeth on each margin. Size large, coloration orangish ..... *cahuilaensis* n. sp.

Foretibiae bearing 3 ventral apical and sub apical spurs, the first two somewhat paired and proximal to the third and fourth calcars, the third subapical in position. Caudal tibiae with a variable number of dorsal apical or subapical teeth on each margin. Size small to very large, coloration dark often with black on head and pronotum in characteristic conformations 3

3. Size large; color of head and pronotum orange red. Head often megacephalic 4
Size medium to small; color of head and pronotum not orange-red but piceus to shining black; the black isolated into irregular areas by pale sutures 5

4. Calcars of the caudal tibiae forming a semi-ringlet of 6 long spurs, the two innermost much the longest and cylindrical in form ..... *longispina* Brunner

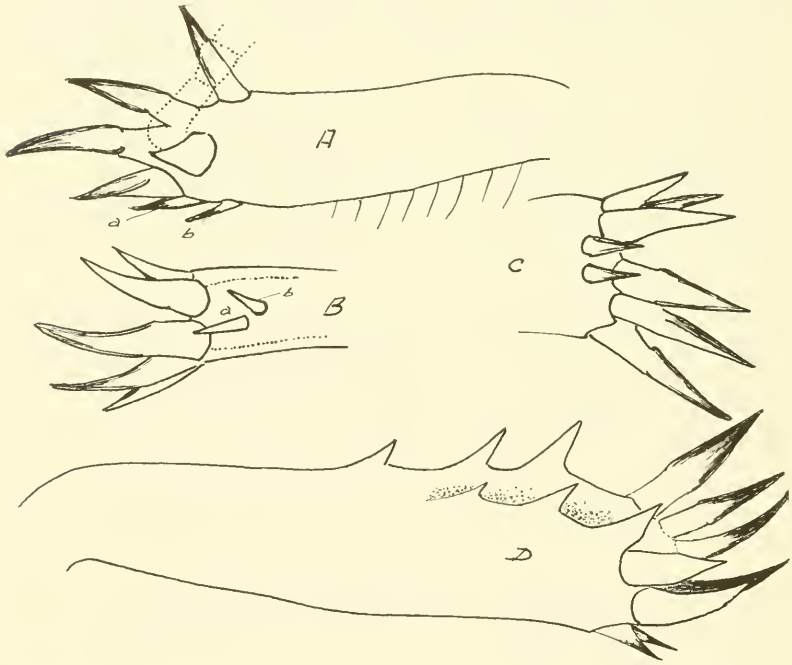
Calcars of the caudal tibiae forming a semi-ringlet of 6 spurs, these spathulate or trowel-shaped on their inner faces; the three inner relatively equal and longer than the 3 outer spurs or calcars ..... *fuscus* Haldeman

5. Entire body uniformly dark brown with black abdominal tergites. Caudal tibiae with 5 internal and 2 external apical dorsal teeth ..... *intermedius* Davis & Smith

Upper half of head shining black with tan sutural areas. Pronotum with dorsum bearing irregular areas of shining black. Femora marked with pale fasciations. Caudal tibiae with 3 to 4 internal and 2 external apical dorsal teeth ..... *pictus* Scudder

Stenopelmatus cahuilaensis n. sp.

Size large for the genus; as the only arenicolous species of *Stenopelmatus* it is recognized from the other Californian species by its orangish coloration, narrow pronotum throughout and certain important chaetotaxical characters. These are: Foretibiae with only two ventral apical spurs whereas all previously described species have three, one of which is subapical in location. Like other species of *Stenopelmatus* in California, the caudal tibiae bear a large pair of ventral apical spurs immediately proximad to calcars 3 and 4. In another new species, description of which is in press by Tinkham and Rentz, this new black-capped species has only one ventral apical spur on the caudal tibiae, as well as only the one pair of



Explanation of Plate

All drawings of the holotype male of *Stenopelmatus cahuilaensis* Tinkham n.sp. greatly enlarged.

A. External view of left fore tibia showing the five calcars and the two ventral apical spurs (a) and (b).

B. Ventral view of left fore tibia showing the pair of ventral apical spurs in relation to the five calcars.

C. Ventral view of apical portions of the left caudal tibia showing the relationship of the pair of ventral apical spurs to the six calcars.

D. External view of the entire caudal tibia showing the three external and three internal dorsal teeth, the six calcars and the ventral pair of apical spurs.

ventral subapical spurs on the fore tibiae. The possession of two ventral apical spurs in a pair on both fore and caudal tibiae will amply distinguish this new species, herein described, from all the other Californian species described or being described.

HOLOTYPE MALE.— 1 male, Palm Springs Depot, Riverside County, California, dunes at north base of mountains one half mile south of depot across wash. Nov. 16, 1963, died Feb. 7, 1964. Collector Ernest R. Tinkham. Type deposited in the Tinkham Eremological Collection.

DESCRIPTION: Size large for the genus. Head large, occiput strongly globose but not megacephalic, clypeal groove to apex of occiput 9.8 mm., from clypeal groove to apex of mandibles 6.2 mm.; breadth of face 10.8 mm. Eyes small, inverted pyriform, inner margins 6.4 mm. apart. Antennae short, barely reaching to the anterior base or segments of the abdomen.

Pronotum with lateral margins anteriorly, not at all expanded or ampliate, but parallel; the posterior half broadly and evenly rounding into the posterior margin which is straight. Anterior margin roundly excavate and typically ciliate with short golden hairs. Dorsum of the pronotum with a shallow, longitudinal, median groove in the posterior three-quarters of the pronotum. There is also a transverse depression on the anterior quarter, another transverse groove centrally which curves forward laterally and at the posterior two-thirds there is a short transverse line for half the breadth of the pronotum. Prosternum with the typical transverse wedge-like process characteristic of the genus.

Abdomen typical; genitalia with supranal plate triangulate, with a slight median transverse depression. Uncinate hooks of the cerci normal and located at the extreme lateral bases of the plate. Cerci bluntly acuminate, medium in length, hirsute. Subgenital plate with the posterior margin broadly and evenly rounded.

Leg spination as follows: fore legs typical in form, fore femora unarmed; fore tibiae with the diagnostic slightly uneven pair of ventral apical spurs. Calcars five, large, the three inner ones the longest and spathulate; the two outer shorter of which the last or fifth is by far the shortest (see fig.). Fore tarsi typical of the genus. Mesolegs with the mesofemora unarmed; mesotibiae with a large pair of even ventral apical spurs at the bases of calcars 3 and 4. There are in addition two subapical spurs, one on each margin and the right mesotibiae has an additional spur, centrally located and just basad of center. Mesotarsi typical. Caudal legs with the femora typical. Caudal tibiae with usually a large pair of ventral apical spurs although in the Type the right pair is missing. Calcars six; the three inner much the longest, their inner apical surfaces spathulate. Dorsal apical teeth usually three on each margin; the external three more closely arranged than the inner three. The Type has also a small extra tooth located about midway along the dorsal inner margin. Caudal tarsi typical.

Calliper measurements of holotype male in millimeters: total length 33.7; pronotum 10.2 in breadth x 7.4 in length; pronotal

depth 4.8; caudal femur 12.6 x 4.3; caudal tibia to base of calcars 11.0; subgenital plate 2.5 in length x 4.4 in width.

Paratype Males.— 4 collected at the Type Locality as follows: 2 males May 1, 1962 and reared as indicated in Life History Studies as "B" and "C." 1 male collected Nov. 16, 1963, and 1 half-grown male collected as a second stadium nymph on July 2, 1964 and died July 1965. 1 male collected at the Palm Springs Airport on April 6, 1968, by Dr. Raymond H. Ten Pas.

Paratypes identical to holotype in every respect except that in "B" and "C" (reared specimens), the terminal tarsal segments and the ungues are atrophied. This may have been due to inactivity in the cartons or in the case of "C" may have resulted from disturbance or handling immediately following ecdysis.

Range in millimeters in paratype males is as follows: Total length 33.5 to 37.5; pronotum 8.5-9.5 in breadth x 6:5-6.9 in length; caudal femura 10.5-12.2 x 4.3 in depth; caudal tibiae to base of calcars 9.4-10.8 mm.

Habitat: rolling sand dune ridges, one above the other, and running parallel to the north base of the San Jacinto mountains. Dune shubbery typical of Colorado Desert. Enormous clumps of ancient creosote (*Larrea divaricata*) form many of the dune ridges. Desert Willow (*Chilopsis linearis*) is also present and forms similar mounds. *Ephedra* or Mormon Tea is also present.

When winter rains have been adequate, the spring flowers are typical of the dunes elsewhere in Coachella Valley. The Dune Primrose (*Oenothera deltoides*) make colorful displays and scent the night air. Brown-eyed Primrose (*Oenothera clavaeformis*), Spectable Pod (*Dithyrea californica*), *Cryptantha micrantha* and *costata*, *Coldenia plicata* forming mats on the sand, wild Rhubarb (*Rumex hymenosepalus*), Sandpaper bush (*Petalonyx Thurberi*) and many other rarer forms are to be found.

Orthopteran Associates: The orthopterans of this area are rather few. In the spring the chief orthopteran is the Giant Sand Treader (*Macrobaenetes valgum* Strohecker) that is to be found occasionally in the spring until late May or early June. The diurnal associates of the area are *Xeracris minimus* on *Petalonyx Thurberi* and *Coniana snowi* on the sand mat *Coldenia plicata*. *Trimerotropis p. pallidipennis* is also present.

Life History Studies

The complete life history of this new species of *Stenopelmatus* dwelling on certain sections of drift sand and sand dunes in the western end of Coachella Valley is compiled from studies on a very young nymph and several half-grown individuals.

On the hot night of July 2, 1964, I arranged to meet and help two men representing a new photographic company they were forming in Los Angeles, at the Palm Springs Depot. I was to assist them in taking movies of night life on the dunes and for my services was to receive a duplicate of several hundreds of feet of the movie

film taken, which was never received. I brought along a sidewinder and other living specimens to make sure of a successful evening. The only recompense I received was the discovery of a young nymph of *Stenopelmatus cahuilaensis* Tinkham n.sp. I was distinctly surprised and delighted to obtain evidently a second stadium nymph of the new species I was anxious to study. The nymph measured between 11 and 12 mm. in length and like all dune biotae undoubtedly emerged from the egg with the advent of the winter rains, probably in late February or early March. The nymph lived for a year and was half grown when it died. Following is the biological record.

July 2, 1964—second stadium nymph discovered on a small dune ridge devoid of vegetation, on a hot night within half an hour of sundown. Length between 11-12 mm.

Sept. 26, 1964—sand in bottom of large oatmeal carton sifted through fine wire mesh to recover any possible parts with negative results.

Oct. 20, 1964—sand sifted—negative results.

Oct. 22, 1964—found complete freshly cast skin or exuvium of 2nd stadium Calliper measurements in millimeters: caudal femora 3.8, caudal tibiae 3.5 to base of calcars.

Nov. 22, 1964—found complete cast skin.

Dec. 19, 1964—examined—negative results.

Feb. 10, 1965—11:30 p.m. when went to feed it lettuce as I did every night, found the nymph in the process of ecdysis. At this time it was lying completely on its back and starting to work its way out of its exuvium. At 11:45 the forelegs had been extricated and by 12:05 midnight it was almost half out.

Feb. 11, 1965—At 8:45 a.m. it was out of its skin but still lying on its back. The exuvium was lying ventral side up. A few minutes later it was on its feet as a result of the examination. Measurements: caudal femur 5.3; caudal tibia 4.2. The complete 4th stadium exuvium was removed and preserved; otherwise it is usually devoured.

April 5, 1965—sifted sand with negative results.

June 27, 1965—as above.

July 18, 1965—found dead—may have been poisoned on lettuce. Measurements of 5th stadium male nymph well preserved in alcohol. Total length 27.3; breadth of head 4.9; pronotum 5.1 in breadth x 3.9 length; caudal femur 6.1; caudal tibia to base of calcars 6.2 mm. This nymph was about the size of the three nymphs collected on May 1, 1962, on which notes are presented below.

"A" half-grown nymph collected May 1, 1962, on dunes about one-half mile south of Palm Springs Depot. Fed small piece of lettuce every night when specimen examined.

Sept. 23, 1962—molted about 11 p.m. At 11:20 p.m. it was lying upside down. Thought for a moment it was dead until I saw the cast skin which was still damp. The weather was very humid

and at 11:40 p.m., the room temperature was 26.0° C; the inside of the carton was 25.8° C. The dorsum of the exuvium was spit from the upper level of the eyes to the base of the first abdominal segments. The mouthparts are drawn far under the exuvium at ecdysis. The exuvium took several days to dry out in the carton in the humid weather. Measurements by callipers in millimeters: pronotal length 6.1 (pronotal breadth cannot be measured due to the split parts); caudal femur 9.6; caudal tibia 8.3 to base of calcars. It is unwise to try to measure the freshly emerged living nymph.

Oct. 8, 1962—living nymph measured 40.0 mm. in total length.

Oct. 16, 1962, 3:50 p.m.—Heard a tapping within the carton at a distance of 8 to 10 feet. Tapping made by abdomen hitting the sand in the bottom of the carton; quite loud at a distance of four feet. Since the carton is dark at all times is this the way the female has in attracting the male to it?

Oct. 24-25, 1962—Heard considerable tapping in the middle of each afternoon. More tapping may have gone on but I was not home every afternoon.

March 8, 1963—found dead.

"B" half-grown male nymph collected May 1, 1962 on dunes about one half mile south of Palm Springs Depot. Fed and examined daily.

July 24, 1962—7:00 p.m., found molting with skin attached.

Oct. 1, 1962—11:35 p.m., found lying sternum up. Room air was 26° C. as the cooler had just been cut off. Temperature within carton was 24.6° C. Cast skin when removed was dry so molting had occurred in the early evening. Measurements of exuvium: pronotal length 7.3; caudal femur 11.2; caudal tibia 10.4 mm.

Oct. 8, 1962—measured 40.0 mm. in total length—living.

Feb. 26, 1963—found dead; measured 36.0 mm.; with head stretched forward, 40.0 mm.

"C" half-grown male nymph collected May 1, 1962 on dunes about one-half mile south of Palm Springs Depot. Fed and examined daily.

July 25, 1962—molted. Sand and air temperature in carton 17.8° C. cast skin present.

Oct. 8, 1962— 11:20 p.m., room temperature 26° C; bottom of carton 24.0° C. nymph found lying on back sternum-up. Cast skin was behind the nymph and dry when it was picked up. Length of nymph 32.0 mm. Nymph very touchy and quick—ready to fight.

Oct. 13, 1962—nymph not doing very well, lying on side, somewhat shrunken.

Oct. 15, 1962—nymph dead, size had shrunk to 26.0 mm. (mostly shrinking of the abdomen). It is suspected that measuring the freshly emerged nymph on Oct. 8, may have accounted for its

premature death as the other two nymphs lived almost half a year longer.

1 male paratype was collected on Nov. 16, 1963 and died in March, 1964. This was a good fall for dune insects since there had been good rains in September and the dunes remained damp or wet all fall and winter.

1 male paratype was collected April 6, 1968, by Dr. Raymond L. Ten Pas at the Palm Springs Airport and died May 22, 1968.

Life History Summary

From the evidence presented the life history of *Stenopelmatus cahuilaensis* Tinkham n.sp. is as follows. The ova are probably deposited in the spring of the year as are those of the sand treaders of the genera *Macrobaenetes* Tinkham and *Ammobaenetes* Hubbell. Whether they hatch that same spring or in the fall after the advent of late summer or early fall rains is not known at present.

The evidence presented does indicate that the nymph takes two full years to mature and that the adult lives at least half a year after maturity is reached. There are at least 7 stadia in the male and perhaps there would be an additional one in the female so that from egg to death of adult can be fully three years or more. This is one year short of the four years of *Ammopelmatus kelsoensis* of the Gila Desert at an elevation of 2500 feet. Perhaps the hotter year-round temperatures of the Colorado Desert account for the shorter life span but even at that three years for an orthopteran is a remarkably long time.

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FAUNISTIC INVENTORY—BYU ECOLOGICAL STUDIES AT THE NEVADA TEST SITE

D Elden Beck[1] and Dorald M. Allred

Introduction

These studies were initiated June 1, 1959, and continued until officially terminated December 31, 1966. They were conducted as cooperative research projects between the United States Atomic Energy Commission and the Department of Zoology and Entomology, Brigham Young University, Provo, Utah. The AEC grants-in-aid were AT(11-1)-786, AT(11-1)-1326, AT(11-1)-1335, and AT(11-1)-1336.

Although December 31, 1966 is the date when AEC sponsorship ceased, data for many aspects of those studies which remain to be completed are available for those specialists who may be interested in the different animal groups.

The main objective of the research projects was to make a faunistic inventory of the test site. The test site was surveyed to determine plant communities characteristic of the areas of our studies. A description of these biotic communities was discussed by Allred, Beck, and Jorgensen (1963a). Studies were then made of areas where nuclear detonations had been conducted and compared with areas where no detonations had taken place. With such baseline data gathered on a year-round basis, better standards of measurement could then be applied to the effects of nuclear testing in this area.

The Nevada Test Site is located in the southeastern part of Nye County, Nevada. It is about 70 miles northwest of Las Vegas, just north of the Las Vegas-Tonopah Highway (U.S. 95). The test site is divided in almost equal north-south halves by a biotic line of demarcation with the Great Basin Province to the north and the Mojave Desert to the south. At the southwestern edge of the site near Forty-mile Canyon the elevation is approximately 2800 feet. At Rainier Mesa in the northcentral region, the elevation is 7694 feet, with some of the surrounding mountains reaching slightly above this level.

Practically all portions of the test site were visited and some surveys conducted. However, the major portions of the site where systematic year-around surveys were made are the lowland desert valleys, basins, playas, and foothills. Much yet remains to be done in a similar manner with the uplands, mesas, and mountainous situations.

Deposition of Collections

Specimens were submitted to specialists for identification from our laboratory at Brigham Young University, Provo, Utah. Upon

1. This report was initially written but not fully completed by the senior author before his untimely death on August 9, 1967. The junior author was concerned mainly in directing the inventory and compiling the data included in Table 1. Condensation and minor changes have been made in the context as initially written by the senior author.

request some specimens were retained by the specialists for further study. We have asked all specialists to recommend institutions and organizations where duplicate specimens of their specialty may be deposited. Priority, of course, is given to Brigham Young University and the USNM.

A complete record of the deposition of all specimens has been maintained, and with the exception of type specimens, all are considered as permanent loans to depositories. This is interpreted as permanent so long as the specimens are properly curated. If at any time these collections are no longer considered useful to the depository, they are to be returned to the United States National Museum. These permanent loans are considered to be continuously available to visiting scientists.

Publications

Schultz (1966) listed the publications dealing with ecological studies at the Nevada Test Site between the years 1953 and 1966. In his listing, those published as part of the Brigham Young University project number over 60. Allred, Beck, and Jorgensen (1966) reported those related to our project in the Proceedings of the Utah Academy of Sciences, Arts, and Letters. After the reports mentioned above were published, three other reports have been prepared —Spiders of the Nevada Test Site (Allred and Beck, 1967), Male Sphaeropthalmine Mutillid Wasps of the Nevada Test Site (Ferguson, 1967), and Miridae of the Nevada Test Site (Knight, 1968). Additional reports will be prepared periodically when identification of additional groups are completed.

Taxonomic Inventory

The following discussion is designed to clarify the data in Table 1.

Column 1. The column on the extreme left, *Group*, refers to the general category in which a group of organisms was tentatively placed for study. It is obvious that some major animal groupings are not shown. This was due to the fact that we had neither the manpower nor facilities to include them in our surveys.

Columns 2 and 3. *Total no. of specimens* and *No. specimens identified* refer to an actual count in some instances and an estimate in others. The numbers in parentheses in these columns refer to actual or estimated numbers of species for each animal group. Some specialists elected only to classify the specimens sent to them, not desiring to publish a report, although in most instances the specialist agreed to make the appropriate descriptions of new genera and species.

Column 4. *Data published* refers to published data, e.g., Barnum (1964), or the specialist who identified or is currently working with the particular taxonomic group. An asterisk indicates that the unidentified specimens have been deposited at the Smithsonian Institution of the USNM pending the availability of a specialist willing to work with that specific group.

TABLE 1. Inventory of arthropods collected at the Nevada Test Site, 1959-1965. (The numbers are based on actual count or visual approximations. Numbers in parentheses indicate the species represented.)

Group	Total no. specimens, all or partly identified	No. specimens unidentified and available	Data published (name and date), specimens in possession of or identified by (name and address), and/or available for study (*)
Insecta			
Thysanura		340	*
Collembola		1700	*
Ephemeroptera (immature)	100		George F. Edmunds, Univ. Utah, Salt Lake City
Odonata			
Anisoptera		160(4)	*
Zygoptera		275(8)	*
Orthoptera	8330(58)		Barnum (1964)
Isoptera		300	*
Embioptera		5	*
Psocoptera		300	*
Mallophaga and Anoplura		530 lots (308 vials, 222 slides)	*
Thysanoptera	6340	280	Lewis J. Stannard, Illinois Nat. Hist., Surv., Urbana
Hemiptera	14,300		
Corixidae		10	*
Notonectidae		10(3)	*
Naucoridae		23(2)	*
Veliidae		65	*
Anthocoridae		40	*
Miridae	315	65	Knight (1967)
Phymatidae		17(8)	*
Reduviidae		100(8)	*
Ploiariidae		10	*
Nabidae		110(3)	*
Tingidae	190(5)	6	Beck and Allred (1966)
Neididae	310(3)	170	ditto
Lygaeidae		3900(18)	*
Coreidae		240(12)	*
Saldidae		1	*
Cydnidae		1	*
Corimelaenidae		46	*
Pentatomidae	250(8)	50	Beck and Allred (1966)
Miscellaneous		486	Carl J. Drake, U.S. Nat. Mus., Washington, D. C.
Immatures		8380	*
Homoptera			
Cicadidae		70(3)	*
Membracidae		225(10)	*
Cicadellidae		1230(40)	*
Cercopidae		5(2)	*
Fulgoroidae		400(30)	*
Psyllidae		240(7)	*
Aphididae	970	140	Clyde Smith, N. Carolina State Univ., Raleigh
Coccoidae		45	*
Immatures		2250	*
Neuroptera			
Myrmeleontidae		200(5)	*
Chrysopidae		150(2)	*
Raphidiidae		15(2)	*

Table 1 (continued)

Group	Total no. specimens, all or partly identified	No. specimens unidentified and available	Data published (name and date), specimens in possession of or identified by (name and address), and/or available for study (*)
Hemerobiidae		12(2)	*
Berothidae		1	*
Immatures		10	*
Coleoptera			
Scarabaeidae	845(20)	33(8)	Allred and Beck (1965)
Curculionidae	315(43)		Tanner (1966)
Platystomidae		6(3)	*
Tenebrionidae	15,675(46)		Tanner and Packham (1965)
Coccinellidae		315(15)	*
Melyridae		400(18)	*
Meloidae		70(8)	*
Dytiscidae		80(3)	*
Hydrophilidae		35(2)	*
Elateridae		425(8)	*
Histeridae		1263(5)	*
Carabidae		575(8)	*
Leptodiridae		375(1)	*
Lathridiidae		110(1)	*
Ptinidae		55(1)	*
Silphidae		65(1)	*
Dermestidae		50(4)	*
Bostrichidae		15(2)	*
Oedemeridae		25(2)	*
Anobiidae		25(4)	*
Cleridae	115(8)	35(7)	William F. Barr, Univ. Idaho, Moscow
Anthicidae		30(4)	*
Chrysomelidae		500(18)	*
Nitidulidae		120(3)	*
Bruchidae		15(4)	*
Mordellidae		20(2)	*
Phengodidae		25(1)	*
Alleculidae		55(3)	*
Silvanidae		25(1)	*
Cryptophagidae		7(1)	*
Elmidae		50(1)	*
Staphylinidae		20(5)	*
Cantharidae		1	*
Ostomidae		1	*
Buprestidae	45(15)	2(1)	William F. Barr, Univ. Idaho, Moscow
Cucujidae		5(1)	*
Pselaphidae		2(1)	*
Lagriidae		1	*
Leiodidae		1	*
Lampyridae		2(1)	*
Cerambycidae		115(15)	*
Miscellaneous		730	*
Immatures		370	*
Trichoptera		135	*
Lepidoptera			
Adults	1413	783(83)	Jerry A. Powell, Univ. Calif., Berkeley
Immatures		270	*
Diptera			

Table 1 (continued)

Group	Total no. specimens, all or partly identified	No. specimens unidentified and available	Data published (name and date), specimens in possession of or identified by (name and address), and/or available for study (*)
Bombyliidae	2630(111)	60	Allred, Johnson, and Beck (1965)
Hippoboscidae		20(1)	*
Sarcophagidae		120(2)	*
Ephydridae		50(2)	*
Tachinidae		160(10)	*
Muscidae		25(1)	*
Bibionidae		30(1)	*
Calliphoridae		65(4)	*
Asilidae		Many	*
Therevidae		8(3)	*
Anthomyiidae		6(1)	*
Dolichopodidae		4(2)	*
Tephritidae		175(8)	*
Cuterebridae		3(1)	*
Chironomidae		65(4)	*
Pipunculidae		2(1)	*
Tipulidae		13(4)	*
Sepsidae		1	*
Syrphidae		55(2)	*
Scenopinidae		3(1)	*
Chloropidae		50(3)	*
Otitidae		1	*
Culicidae		4(1)	*
Conopidae		14(2)	*
Mydidae		2(1)	*
Heleomyzidae		13(4)	*
Miscellaneous		885(60)	*
Immatures		1230	*
Siphonaptera	3720(33)	9	Beck and Allred (1966)
Hymenoptera			
Formicidae	4500(53)	1050	Cole (1966)
Mutillidae	120	8	Ferguson (1967)
Tiphiidae	575		Marius Wasbauer, Calif. Dept. Agr., Sacramento
Apoidae	353		George E. Bohart, Utah State Univ., Logan
Miscellaneous		925(90)	*
Immatures		1100	*
Crustaceans			
Isopoda	500(2)	15	*
Branchiopoda	120		George F. Edmunds, Univ. Utah, Salt Lake City
Ostracoda	90	40	ditto
Diplopoda	156(4)	4	R. V. Chamberlin, Univ. Utah, Salt Lake City
Chilopoda	85(5)	3	ditto
Symphyla		1	*
Pauropoda		1	*
Scorpionida	1710(9)	240	Gertsch and Allred (1965)
Solpugida	1000(28)	45	Muma (1963)
Pseudoscorpionida		77	*
Phalangida	1700(2)		Allred (1965)
Acarina			
Mites	15,800(200)	172 lots (vials)	Allred (1963a; 1963b; 1963c); Allred and Beck

Table 1 (continued)

Group	Total no. specimens, all or partly identified	No. specimens unidentified and available	Data published (name and date), specimens in possession of or identified by (name and address), and/or available for study (*)
			(1962; 1964); Allred and Goates (1964a; 1964b); Goates (1963) C. D. Jorgensen, Brigham Young Univ., Provo, Utah
Ticks	1900(11)		Beck, Allred and Brinton (1963)
Araneida	5600(91)	370	Allred and Beck (1967)
Reptilia	700(29)		Tanner and Jorgensen (1963)
Aves	900(187)		Hayward, Killpack, and Richards (1963)
Mammalia	954(46)		Jorgensen and Hayward (1965)

List of Depositories of Nevava Test Site Specimens

American Museum of Natural History
(Dr. Willis Gertsch)
Central Park West at 79th Street
New York, New York 10000
Coleoptera, Hymenoptera, Isopods, Mites, Orthoptera, Scorpions

Arizona State University
(Dr. Mont A. Cazier)
Department of Zoology
Arizona State University
Tempe, Arizona 85281
Coleoptera, Diptera, Hymenoptera, Isopods, Orthoptera, Solpugids, Scorpions

Bishop Museum
(Dr. Nixon Wilson)
Department of Entomology
Honolulu, Hawaii 96800
Coleoptera, Hymenoptera, Mites, Orthoptera

Brigham Young University
(Dr. Dorald M. Allred)
Department of Zoology and Entomology
Provo, Utah 84601
Birds, Chilopods, Coleoptera, Diplopods, Diptera, Ephemeroptera, Hemiptera, Hymenoptera, Isopods, Lepidoptera, Mammals, Mites, Orthoptera, Phalangids, Reptiles, Scorpions, Solpugids, Spiders, Trichoptera

California Academy of Science
(Mr. Hugh B. Leech)
Golden Gate Park
San Francisco, California 94100
Coleoptera, Hymenoptera, Isopods, Mites, Orthoptera, Scorpions

Chicago Natural History Museum
Coleoptera, Hymenoptera, Isopods, Orthoptera, Scorpions, Mites

Colorado State University
(Dr. Tyler A. Woolley)
Department of Zoology
Ft. Collins, Colorado 80521
Coleoptera, Hymenoptera, Mites, Orthoptera

Communicable Disease Center
(Dr. Harry D. Pratt)

U. S. Public Health Service
50 Seventh Street, N. E.
Atlanta, Georgia 30300
Mites

Death Valley National Monument Museum
(Mr. Dwight T. Warren)
Chief Naturalist
Death Valley Museum
Death Valley, California 92328
Chilopods, Coleoptera, Diptera, Hymenoptera, Isopods, Orthoptera, Scorpions, Sulpugids

Dixie College
(Dr. Andrew H. Barnum)
Department of Biology
St. George, Utah 84770
Coleoptera, Hymenoptera, Orthoptera, Scorpions, Reptiles

Florida Department of Agriculture
(Dr. H. A. Denmark)
P. O. Box 1269
Seagle Building
Gainesville, Florida 32601
Hymenoptera

Long Beach State College
(Dr. Richard B. Loomis)
Department of Biology
Long Beach, California 90800
Mites

Los Angeles County Museum
(Dr. Charles L. Hogue)
Exposition Park
Los Angeles, California 90000
Hymenoptera, Coleoptera, Orthoptera

Museum of Comparative Zoology (Harvard)
(Dr. Howard E. Evans)
Insect Department
15 Divinity Ave.
Cambridge, Massachusetts 02100
Coleoptera, Hymenoptera, Isopods, Orthoptera, Scorpions

New Mexico Highlands University
(Dr. Lora M. Shields)
Department of Biology
Las Vegas, New Mexico 87701
Hymenoptera, Reptiles

Ohio Agriculture Experiment Station
(Dr. Donald E. Johnston)
Institute of Acarology
Department of Zoology and Entomology
Wooster, Ohio 44691
Hymenoptera, Mites

Philadelphia Academy of Natural Science
(Mr. Harold J. Grant, Jr.)
Department of Insects
Nineteenth and the Parkway
Philadelphia, Pennsylvania 19100
Coleoptera, Hymenoptera, Isopods, Mites, Orthoptera, Scorpions

Rocky Mountain Laboratory
(Dr. James M. Brennan)
Hamilton, Montana 59840
Mites

San Jose State College
(Dr. William E. Ferguson)
(Biology Department
San Jose, California 95114
Coleoptera, Hymenoptera, Orthoptera

U. S. National Museum
(Dr. J. F. Gates Clark)
Division of Insects
Washington, D. C. 20260
Coleoptera, Hymenoptera, Isopods, Mites, Orthoptera, Scorpions

University of California (Berkeley)
(Dr. Deane P. Furman)
Department of Entomology and Parasitology
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Berkeley, California 94700
Coleoptera, Hymenoptera, Mites, Orthoptera

University of California (Los Angeles)
Department of Entomology and Parasitology
University of California
Los Angeles, California 90000
Mammals

University of California (San Francisco)
(Dr. J. Ralph Audy)
George Williams Hooper Foundation
San Francisco Medical Center
San Francisco, California 94122
Mites

University of Florida
(Dr. Martin H. Muma)
Citrus Experiment Stations
P. O. Box 1088
Lake Alfred, Florida 33850
Solpugids

University of Kansas
(Dr. Joseph H. Camin)
Department of Entomology
Lawrence, Kansas 66044
Coleoptera, Hymenoptera, Mites, Orthoptera

University of Michigan
(Dr. Theodore H. Hubbell)
Museum of Zoology
Ann Arbor, Michigan 48103
Coleoptera, Hymenoptera, Mites, Orthoptera, Scorpions

University of Nevada (Las Vegas)
(Mr. W. G. Bradley)
Southern Regional Division
Las Vegas, Nevada 89100
Coleoptera, Hymenoptera, Isopods, Mammals, Mites, Orthoptera, Scorpions

University of Nevada (Reno)
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Coleoptera, Hymenoptera, Isopods, Mites, Orthoptera, Scorpions

University of Tennessee
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Knoxville, Tennessee 37900
Coleoptera, Hymenoptera, Orthoptera, Mites

University of Utah
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Salt Lake City, Utah 84117
Birds, Coleoptera, Hymenoptera, Isopods, Mites, Orthoptera

Utah State University
(Dr. Datus Hammond)
Department of Zoology
Logan, Utah 84321
Coleoptera, Hymenoptera, Mites, Orthoptera, Scorpions

Virginia Polytechnic Institute
(Dr. R. B. Holliman)
Department of Biology
Blacksburg, Virginia 24066
Mites

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REDESCRIPTION OF *MICROZETES AUXILIARIS APPALACHICOLA* JACOT (ACARI: CRYPTOSTIGMATA, MICROZETIDAE)[1]

Harold G. Higgins[2] and Tyler A. Woolley[3]

ABSTRACT

In the original work on this race, Jacot (1938) neither figured nor adequately separated this form from the species *auxiliaris*. The race is figured and a short diagnostic description made for clarification.—H.G.H.

Jacot, in 1938, described *Microzetes auxiliaris appalachicola* from specimens taken from mossy interspaces of *Andropogon* sod, old field, Case Place, Bent Creek Exp. Forest, North Carolina on 6 February 1935. These specimens were placed on his slide 34F24-3. At the time Jacot made his description, he wrote only four lines and made no drawing of this new taxon. Since that time several writers including Balogh (1962b) and Higgins (1965) have commented upon the problem that was associated with the identification of this species. Recently in an attempt to identify a small collection of *Microzetes* from the Southern States, an effort was made to compare them with the species described by Jacot. A single cotype, taken from the original slide and labeled *Microzetes appalachicola*, became available for study. This specimen, unfortunately, has a dark spot in the area of the lamellar hair and appears to be mounted in balsam making easy remounting impossible. Nevertheless, this specimen appears to be similar in other respects to our specimens from Mississippi and Louisiana. A short diagnostic description with figures follows.

Microzetes auxiliaris appalachicola Jacot

Similar to *Microzetes auxiliaris* Grandjean, but differing in the following aspects: Lamellae long, reaching to tip of rostrum; inner edge of lamellar cusp longer than lateral edge; apex of cuspis without incision; lamellar hairs long, extending beyond tip of cusps with long cilia as shown in Fig. 2; interlamellar hairs long, rising on lamellae and tapered abruptly near the tip (Fig. 3); lamellar apophysis on inner margin of lamellae long, decurved, with a single dorsal projection.

Ventral surface and setae similar to M. *auxiliaris*. Length, 174μ x 126μ.

Specimens Examined

Louisiana: Four specimens from Gonzales, Ascension Parish, 16 October 1953 by H. S. Dybas.

1. Research supported in part by TG-701-A-1000094-09 NIH-NIAID.
2. Participant in NSF Research Participation for High School Teachers Program, Colorado State University.
3. Department of Zoology, Colorado State University.

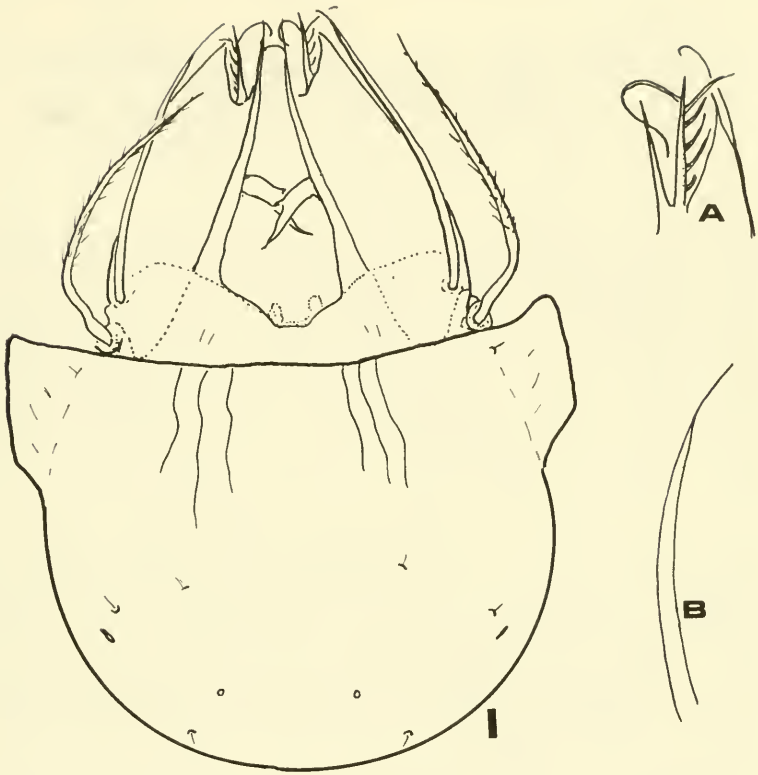

Fig. 1. Dorsal view of *Microzetes auxiliaris appalachicola* Jacot.
Fig. 1A. Tip of lamellae showing lamellar hair.
Fig. 1B. Tip of interlamellar hair.

Mississippi: Thirteen specimens from Tunica, Mississippi. 9 July 1939 by N. Park.

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A NEW GENUS AND SPECIES OF ORIBATID FROM PACK RAT NESTS (ACARI: CRYPTOSTIGMATA, TECTOCEPHEIDAE)[1]

Tyler A. Woolley[2] and Harold G. Higgins[3]

ABSTRACT

In a study of oribatids from pack rat nests in Utah a new genus and species of oribatids was found. The new form *Exochocepheus eremitus*, gen. n., sp. n., is compared with *Niphocepheus* and *Lamellocepheus*, but is differentiated on the basis of the cerotegument, lamellae, translamella and prodorsal hairs.—T.A.W.

When Travé (1959) erected the new family Niphyocepheidae and described two new subspecies within the monotypical genus, he cited Balogh (1943) as the author of the type genus, *Niphocepheus*, and Schweizer (1922) as the describer of the original species (*Cepheus nivalis*) from which the generic name was modified. Balogh (1965) listed the family and the genus in his synopsis of world genera.

In a study of oribatids collected from pack rat nests we found a series of mites that are like *Niphocepheus* in the appearance of the lamellae, the lamellar hairs and general features, but differ in the fewer setae (6 compared to 13-18) on the genital covers. This new species is also like *Lamellocepheus* in other features. The cerotegument is reticulate in pattern rather than longitudinal ridges as in *Niphocepheus;* large spines are found on the tarsi and tibiae of the legs. The sensilli of the new species are different from either *Niphocepheus* or *Lamellocepheus*.

We have not found in the literature any described oribatids that resemble these new forms either from free-living soil mites or from recorded inhabitants of pack rat nests and have concluded that these mites constitute a new genus and species. This new form is described below with a name that indicates its resemblance to the projecting lamellae of *Niphocepheus* and also refers to the desert type of habitat in which it is found.

Exochocepheus eremitus, gen. n., sp. n.
(Figs. 1-5)

Diagnosis: Prodorsum resembles *Nichocepheus* in general shape of the lamellae and attached cerotegument, but with lamellae separated medially rather than fused and without a complete translamella; the sensillus is clavate and spined, at least a third longer than the sensillus in *Nichocepheus* in comparative length and without as large a head as in *Lamellocepheus*. The lamellae of the new species are most similar to those of *Lamellocepheus*, but exhibit a slight incomplete translamella compared to the complete absence of this feature in *Lamellocepheus*. The six pairs of genital setae and the

1. Research supported in part by TG-701-A-1000094-09 NIH-NIAID.
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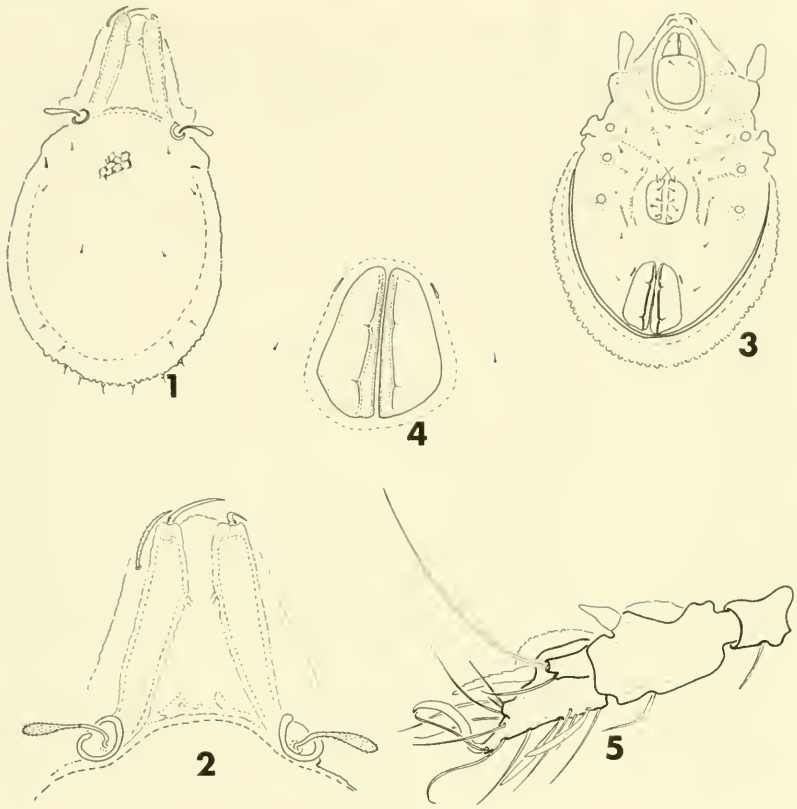

Fig. 1. Dorsum of *Exochocepheus eremitus*, gen. n., sp. n., with cerotegument in place; legs omitted.
Fig. 2. Enlarged view of prodorsum of *E. eremitus*, gen., n., sp. n.
Fig. 3. Venter of *E. eremitus*, gen. n., sp. n., with cerotegument in place, legs partially shown.
Fig. 4. Enlarged view of anal covers of *E. eremitus*, gen. n., sp. n.
Fig. 5. Genu, tibia, tarsus of leg I of *E. eremitus*, gen. n., sp. n., from lateral aspect.

feature in *Lamellocepheus*. The six pairs of genital setae and the large leg spines in this genus and species are the bases for placement in the Tectocepheidae rather than the Niphocepheidae. The generic name is formed from the Greek *exochos*, meaning jutting out or projecting and refers to the lamellae; the trivial name derives from the Greek *eremites* and implies desert dweller.

Description: Color yellow-brown; integumental surface obscured by rugose cerotegument; rostrum irregular in outline, rostral hairs finely barbed, curved, inserted posterior to level of lamellar hairs; lamellae narrowed, covered with a translucent cerotegument, curved laterally to meet the pseudostigmata; lamellar hairs hook-like or strongly decurved, smooth most of length of hair, finely barbed at base of hair shaft near insertion (Fig. 2), inserted in tips of round-

ed lamellar cusps, extending through circular channels in cerotegument into areolae in distal tips of lamellae; translamella nearly absent except for small, medial sclerotized points about a third the length of lamellae posteriorly; pseudostigmata circular in outline, widely opened, sensillus clavate and distinctly spined, spines extended down two-thirds length of sensillus toward base, head longer than pedicel; tectopedia I with outer covering of cerotegument.

Hysterosoma nearly round, narrowed posteriorly in some specimens, covered with cerotegument of reticulate surface pattern; distinctly squared shoulders posterior to pseudostigmata; visible dorsal setae and fissures as seen in Fig. 1.

Camerostome elongated, broken in type specimen; ventral apodemata and setae as in Fig. 3; genital aperture between levels of legs III and IV, nearly square, each genital cover with six setae; g:1 near anteromedial corner, at least twice as long as other setae; g:2 either lateral to or slightly posterior to g:1; g:3, g:4, g:6 inserted about same distance from medial margin equidistant from each other; g:5 displaced laterally; aggenital setae laterad of genital and anal openings, inserted subequal distance from each opening; anal opening pentagonal, larger and more elongated than genital; each anal cover is divided by a longitudinal ridge, closer to medial margin than to lateral; anal setae inserted in slight emarginations of ridge in anterior and posterior thirds of cover (Fig. 4); fissure *iad* near anterolateral margin of anal opening; only one pair of adanal setae observed in type (ada:3) (Fig. 4).

Legs heterotridactylous, medial claw much larger than fine, hair-like laterals; large spine on tibia and tarsus I (Fig. 5) and all other legs; tibial solendion of leg I in large prominence with subapical seta, other setae as seen in Fig. 5.

Measurements: Total length 492μ from tip of lamella to posterior margin, cerotegument included, prodorsum 132μ; width at widest part of hysterosoma 283μ.

Collection Data: The type specimen is a male and slightly broken, the drawing is partially reconstructed. The type was drawn from slide 1326.037, University of Utah-Ecol. Res. Thirteen specimens, 10 males, two females and one undertermined sex, were taken from a *Neotoma* nest, Cedar Mountains, Tooele Co., Utah, 22 June 1953 by W. Thomas; two males were from Bicknell, Utah, one taken 19 March 1949, one taken 29 March 1951, both by Harold G. Higgins; one specimen of undetermined sex was collected from a *Neotoma* nest at Sigurd, Utah, 9 April 1949, by S. Mulaik.

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NOMENCLATURE CHANGES IN THE ALASKAN FLORA

Stanley L. Welsh[1]

Floristics revisions generally lead to adjustments in nomenclature and to the description of previously undescribed entities. This is the case with the revision of the Alaskan flora also. The necessity for changes of nomenclature is a result of increased knowledge about entities, the examination of additional or unusual specimens, the filling in of gaps in distributional records, and differences in point of view on what constitutes a taxon and on what level it should be recognized. All nomenclatural changes have been checked against the most modern treatments for the groups in which they belong and against standard indices of botanical literature.

Specimens on which new entities are based are deposited in herbaria designated by standardized international code letters.

The conclusions presented here represent the results of four years of intensive study of Alaskan flora. That some of the interpretations might be in error is hereby granted, and for the errors the writer herewith submits his apologies. Hopefully, the changes reported here will lead to a more stable nomenclature and to better understanding of a vastly interesting flora. Justification for the conclusions reached here will be more readily apparent when the proposed revision of *Anderson's Flora of Alaska* appears in print.

The writer wishes to thank Dr. Richard W. Pohl, administrator of the Anderson bequest to Iowa State University for financial aid necessary to complete this study. Gratitude is also expressed to Dr. Duane Isely for his support and encouragement.

BORAGINACEAE

Mertensia maritima (L.) S. F. Gray var. *asiatica* (Takeda) Welsh stat. nov. (based on: *Mertensia maritima* ssp. *asiatica* Takeda Jour. Bot. 49:222. 1911)

Mertensia paniculata (Ait.) G. Don ssp. *eastwoodiae* (Macbr.) Welsh stat. nov. (based on: *Mertensia eastwoodiae* Macbr. Contr. Gray Herb. n. s. 49:18. 1917)

CARYOPHYLLACEAE

Arenaria laricifolia L. var. *hultenii* Welsh var. nov.

Planta similis var. laricifolia, differens in folia obtusa, linearia ad anguste oblonga, pleurumque uninervis et glabra vel tantum ciliata. Alaska: Takotna, Anderson & Gasser 7398, 24 July 1941 (ISC, holotype; BRY, isotype). Additional specimens from Alaska: Unalakleet, Anderson 5088, 29 August 1938 (ISC, BRY); Takotna Mt., R. L. Layden 167, 9 July 1948 (ISC); Mt. Fairplay, Anderson

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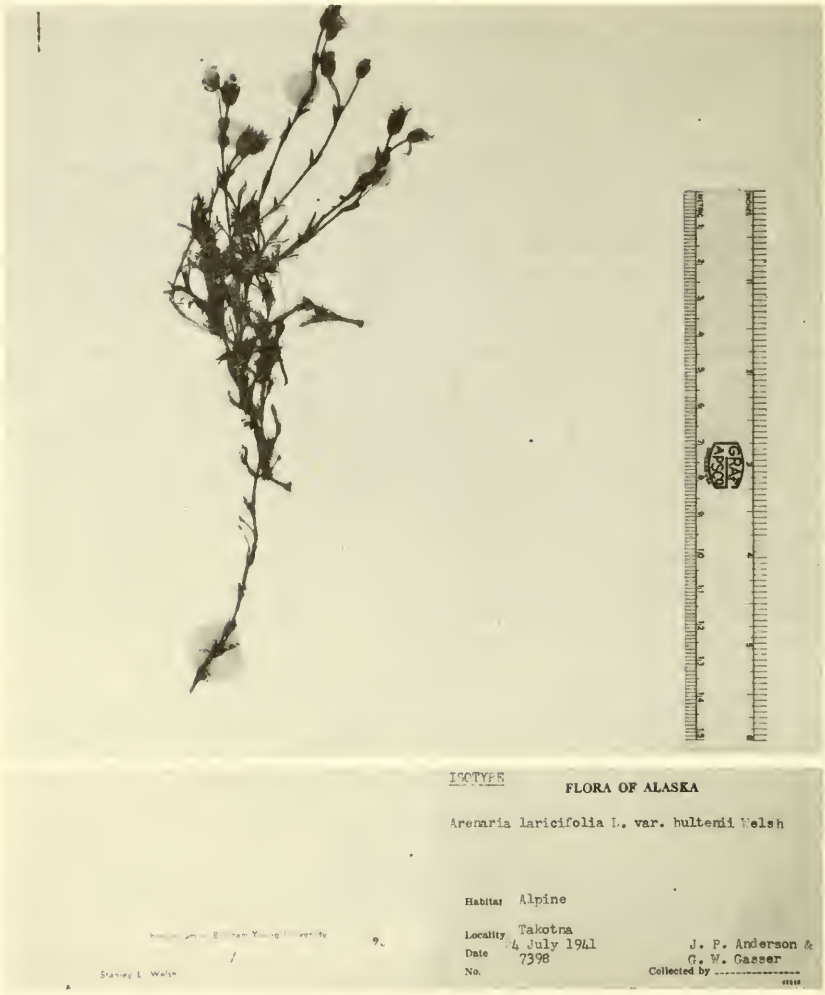

Figure 1. Isotype of *Arenaria laricifolia* L. var. *hultenii* Welsh var. nov.

10810. 22 July 1948 (ISC); Mt. McKinley National Park. Nelson & Nelson 3898. 21 July 1939 (ISC); Golovin, Anderson 5038. 27 August 1938 (ISC). This variety is named in honor of Eric Hultén, distinguished student of Alaskan botany.

Arenaria rossii R. Br. ex Richards. var. *elegans* (Cham. & Schlecht.) Welsh stat, nov. (based on: *Arenaria elegans* Cham. &. Schlecht. Linnaea 1:57. 1826)

Cerastium beeringianum Cham. & Schlecht. var. *aleuticum* (Hultén) Welsh comb. nov. (based on: *Cerastium aleuticum* Hultén Svensk. Bot. Tidskr. 30:520. 1936)

CHENOPODIACEAE

Atriplex patula L. var. *alaskensis* (Wats.) Welsh stat. nov. (based on: *Atriplex alaskensis* Wats. Proc. Am. Acad. 9:108. 1874)

COMPOSITAE

Antennaria alpina (L.) Gaertn. var. *stolonifera* (Porsild) Welsh comb. nov. (based on: *Antennaria stolonifera* Porsild Can. Field-Nat. 64:16. 1950)

Antennaria alpina (L.) Gaertn. var. *megacephala* (Fern.) Welsh comb. nov. (based on: *Antennaria megacephala* Fern. ex Raup Contr. Arnold. Arb. 6:208. 1943)

Antennaria alpina (L.) Gaertn. var. *compacta* (Malte) Welsh comb. nov. (based on: *Antennaria compacta* Malte Rhodora 36:111. 1934)

Arnica alpina (L.) Olin var. *lonchophylla* (Greene) Welsh comb. nov. (based on: *Arnica lonchophylla* Greene Pittonia 4:164. 1900)

Arnica amplexicaulis Nutt. var. *prima* (Maguire) Welsh stat. nov. (based on: *Arnica amplexicaulis* ssp. *prima* Maguire Madroño 6:154. 1942)

Arnica chamissonis Less. var. *incana* (Gray) Welsh stat. nov. (based on: *Arnica foliosa* var. *incana* Gray Am. Nat. 8:213. 1874)

Arnica louiseana Farr. var. *frigida* (Meyer ex Iljin) Welsh stat. nov. (based on: *Arnica frigida* Meyer ex Iljin Trav. Mus. Bot. Acad. U. R. S. S. 19:112. 1926)

Artemisia campestris L. ssp. *borealis* (Pallas) H. & C. var. *canadensis* (Michx.) Welsh comb. nov. (based on: *Artemisia canadensis* Michx. Fl. Bor. Am. 2:128. 1803)

Artemisia campestris L. ssp. *borealis* (Pallas) H. & C. var. *strutzae* Welsh var. nov.

A var. borealis differt foliis dense pilosis et inflorescentiis subpaniculatis vel paniculatis. ALASKA: Roadside, ca. 2 miles east of Potter, near mile 112 Seward Highway, Welsh 4524, 7 July 1965, (BRY, holotype; ISC, isotype). Additional specimens from Alaska: Cliffs along Turnagain Arm, along Highway 1, 25 miles south of Anchorage, Welsh 4115, 14 June 1965 (BRY, ISC); Glenn Highway, ca. mile 112, near Sheep Mountain, Strutz 44, 18 June 1953 (BRY); Seward Highway, mile 105, Strutz 1967-1 (BRY); Seward Highway, mile 108.5, do 1967-2 (BRY); Seward Highway, mile 113, do 1967-3 (BRY); Seward Highway, mile 113, do 1967-4a, 1967-4b (BRY); Seward Highway, mile 115, do 1967-5 (BRY), all 20 August 1967; Seward Highway, mile 16, Williams 1566, 22 June 1966 (BRY). This variety is named in honor of Mrs. Aline Strutz, botanical enthusiast, collector, and Alaskan pioneer.

Artemisia frigida L. var. *williamsae* Welsh var. nov.

Figure 2. Holotype of *Artemisia campestris* L. ssp. *borealis* (Pallas) H. & C. var. *strutzae* Welsh var. nov.

A var. frigida differt receptaculis glabris vel glabratis et capitulis saepe supra 5 mm. latis. YUKON TERRITORY: Alaska Highway, mile 1070, at Kluane Lake, on lakeshore gravel, Williams 1369, 31 July 1965 (BRY, holotype). Additional specimens: YUKON TERRITORY: Along Alaska Highway, at Duke River, Williams 1888, 26 July 1966 (BRY). ALASKA: Glenn Highway, mile 113, Strutz 45, 18 June 1953 (BRY, ISC). This variety is named in honor of Mrs.

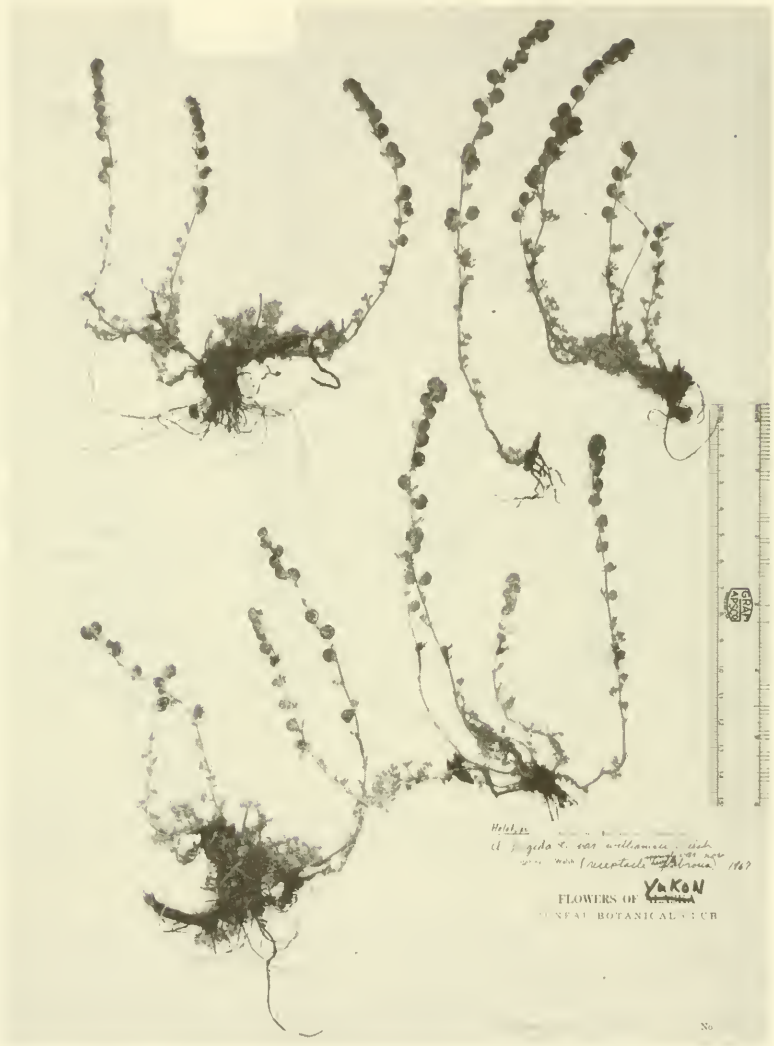

Figure 3. Holotype of *Artemisia frigida* L. var. *williamsae* Welsh var. nov.

Maxine Morgan Williams, long-time Alaskan resident and botanical collector.

Artemisia norvegica Fries var. *comata* (Rydb.) Welsh comb. nov. (based on: *Artemisia comata* Rydb. N. Am. Fl. 34:263. 1916)

Artemisia tilesii Ledeb. var. *aleutica* (Hultén) Welsh comb. nov. (based on: *Artemisia unalaskensis* var. *aleutica* Hultén Fl. Aleutian Isl. 327. 1937)

Saussurea angustifolia (Willd.) DC. var. *viscida* (Hultén) Welsh comb. nov. (based on: *Saussurea viscida* Hultén Lunds Univ. Arssk. N. F. Avd. 2. 46:1627. 1950)

Tanacetum bipinnatum (L.) Schultz-Bip. ssp. *huronense* (Nutt.) Welsh stat. nov. (based on: *Tanacetum huronense* Nutt. Gen. 2:141. 1818)

CRUCIFERAE

Cochlearia officinalis L. var. *sessilifolia* (Rollins) Welsh stat. nov. (based on: *Cochlearia sessilifolia* Rollins Contr. Dudley Herb. 3: 182. p. 46, fig. 1. 1941)

Draba borealis DC. var. *maxima* (Hultén) Welsh comb. nov. (based on: *Draba maxima* Hultén Lunds Univ. Arssk. N. F. Avd. 2. 41:859. 1944)

Erysimum asperum (Nutt.) DC. var. *angustatum* (Rydb.) Welsh comb. nov. (based on: *Erysimum angustatum* Rydb. Bull. N. Y. Bot. Gard. 2:171. 1901)

Rorippa islandica (Oed.) Borbas var. *barbaraeifolia* (DC.) Welsh comb. nov. (based on: *Camelina barbaraeifolia* DC. Syst. Nat. 2:517. 1821)

GENTIANACEAE

Gentianella propinqua (Richards.) Gillett var. *aleutica* (Cham. & Schlecht.) Welsh stat. nov. (based on: *Gentiana aleutica* Cham. & Schlecht. Linnaea 1:175. 1826)

LEGUMINOSAE

Hedysarum boreale Nutt. ssp. *mackenzii* (Richards.) Welsh stat. nov. (based on: *Hedysarum mackenzii* Richards. Bot. Append. Frankl. Journ. 745. 1823)

Oxytropis arctica R. Br. var. *barnebyana* Welsh var. nov.

Herba perennis acaulescens, caudices multi vel pauci-ramosis, ramuli brevis; folia pinnatis, 6-15 cm. longis; foliola 9-15, oblongis vel lanceolatis oppositis vel alternis, 4-15 mm. longis, 2-5 mm. latis, obtusis vel acutis, aliquantum pilosis supra et infra; stipulae et petioli adnatis; scapi foliis longior, 5- ad 8-floribus; corollae albus, apicibus carinis purpureo-maculatis, 18-22 mm. longis; legumina adscendens, substipitatis, biloculis, 18-25 mm. longis.

Acaulescent perennial herbs from a branching caudex; leaves pinnate, 6-15 cm. long, the leaflets 9-15, oblong to lanceolate, opposite or alternate, not fasciculate, 4-15 mm. long, 2-5 mm. broad, obtuse to acute, somewhat pilose on both surfaces; stipules adnate to the petioles, 10-25 mm. long, the free ends acuminate, 7-12 mm. long, pilose dorsally, becoming glabrate in age, ciliate and beset with clavate marginal processes; scapes 9-15 (20) cm. long; rachis of raceme 0.5-4.5 cm. long; flowers white, fading cream or yellowish, the keel-tip maculate; calyx cylindric, villous with light and dark

Figure 4. Holotype of *Oxytropis arctica* R. Br. var. *barnebyana* Welsh var. nov.

in mixed *Salix* heath, Welsh 5729, 9 July 1966 (BRY, holotype; ISC, NY, US, ALA, isotypes). Additional specimens: Kotzebue, Welsh 5758, 10 July 1966 (BRY, ISC); do, Anderson 4740b, 12 August 1938 (ISC); do, Strutz 432, 26 June 1963 (BRY); do, Strutz 1021, 9 July 1966 (BRY); do, Welsh 5841, 13 July 1966; Sadlerochit R., Spetzman 950, 30 July 1948 (BRY, mixed collection). This variety is abundant near Kotzebue. It is named in honor of Rupert C. Barneby, monographer of North American *Oxytropis*.

R., Spetzman 950, 30 July 1948 (BRY, mixed collection). This variety is abundant near Kotzebue. It is named in honor of Rupert C. Barneby, monographer of North American *Oxytropis*.

ONAGRACEAE

Epilobium alpinum L. var. *sertulatum* (Hausskn.) Welsh comb. nov. (based on: *Epilobium sertulatum* Hausskn. Österr. Bot. Zeits. 29:52. 1879)

Epilobium alpinum L. var. *behringianum* (Hausskn.) Welsh comb. nov. (based on: *Epilobium behringianum* Hausskn. Mon. Epil. 277. 1884)

Epilobium palustre L. var. *davuricum* (Fisch. ex Hornem.) Welsh comb. nov. (based on: *Epilobium davuricum* Fisch. ex Hornem. Hort. Hafn. Suppl. 44. 1819)

POLEMONIACEAE

Phlox sibirica L. var. *alaskana* (Jordal) Welsh stat. nov. (based on: *Phlox alaskana* Jordal Rhodora 54:38. 1952)

Phlox sibirica L. var. *borealis* (Wherry) Welsh comb. nov. (based on: *Phlox borealis* Wherry Morris Arboretum Monog. 3:126. 1955)

Phlox sibirica L. var. *richardsonii* (Hook.) Welsh comb. nov. (based on: *Phlox richardsonii* Hook. Fl. Bor. Am. 2:73. tab. CLX. 1840)

POLYGONACEAE

Polygonum alpinum All. ssp. *alaskanum* (Small) Welsh stat. nov. (based on: *Polygonum alpinum* All. var. *alaskanum* Small Monog. 33. 1895)

PORTULACACEAE

Montia bostockii (Porsild) Welsh comb. nov. (based on: *Claytonia bostockii* Porsild Bull. Nat. Mus. Can. 121: 160. 1951)

Montia scammaniana (Hultén) Welsh comb. nov. (based on: *Claytonia scammaniana* Hultén Bot. Nat. 1939:826. 1939)

PRIMULACEAE

Dodocatheon pulchellum (Raf.) Merrill var. *alaskanum* (Hultén) Welsh stat. nov. (based on: *Dodocatheon macrocarpum* var. *alaskanum* Hultén Lunds Univ. Arssk. N. F. Avd. 2. 44:1289. 1948)

RANUNCULACEAE

Aconitum delphinifolium DC. var. *paradoxum* (Reichb.) Welsh stat. nov. (based on: *Aconitum paradoxum* Reichb. Monogr. Gen. Aconit. 76. tab. 10, fig. 3-5. 1820)

Anemone narcissiflora L. var. *villosissima* (DC.) Welsh stat. nov. (based on: *Anemone narcissiflora villosissima* DC. Prodr. 1:22. 1824)

ROSACEAE

X Geum macranthum (Kearney ex Rydb.) Welsh hybrid nov. (based on: *Sieversia macrantha* Kearney ex Rydb. N. Am. Fl. 22:412. 1913)

SAXIFRAGACEAE

Saxifraga davurica Willd. var. *grandipetala* (Engler & Irmscher) Welsh stat. nov. (based on: *Saxifraga davurica* Willd. fma. *grandipetala* Engler & Irmscher ex Engler Pflanzenreich IV. 117 (heft 67): 22. 1916)

Saxifraga punctata L. var. *insularis* (Hultén) Welsh stat. nov. (based on: *Saxifraga punctata* ssp. *insularis* Hultén Svensk. Bot. Tidskr. 30:524. 1936)

Saxifraga punctata L. var. *porsildiana* (Calder & Savile) Welsh stat. nov. (based on: *Saxifraga punctata* ssp. *porsildiana* Calder & Savile Can. Jour. Bot. 38:429. 1960)

Saxifraga punctata L. var. *pacifica* (Hultén) Welsh stat. nov. (based on: *Saxifraga punctata* ssp. *pacifica* Hultén Lunds Univ. Arssk. N. F. Avd. 2. 40:928. 1944)

SCROPHULARICEAE

Euphrasia arctica Lange ex Rostrup var. *mollis* (Ledeb.) Welsh comb. nov. (based on: *Euphrasia officinalis* var. *mollis* Ledeb. Fl. Ross. 3:263. 1849)

Pedicularis sudetica Willd. var. *pacifica* (Hultén) Welsh stat. nov. (based on: *Pedicularis sudetica* ssp. *pacifica* Hultén Svensk Botanisk Tidskr. 55:203. 1961)

Veronica wormskjoldii Roem. & Schult. var. *stelleri* (Pallas) Welsh comb. nov. (based on: *Veronica stelleri* Pallas ex Schrad. & Link Bot. Jahrb. 3:40. 1820)

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A NEW VARIETY OF ERIOGONUM UMBELLATUM FROM SOUTHERN NEVADA

James L. Reveal[1, 2]

In a series of *Eriogonum* specimens received for study from the Nevada Test Site in the fall of 1967 I discovered a local population of *E. umbellatum* Torr. which seemed to represent an undescribed variety in this exceedingly complex species. During the growing season of 1968, I had an opportunity to work on the Test Site and study this population in the field. The original suspicions that it was undescribed were confirmed, and the new variety is now proposed as:

Eriogonum umbellatum Torr. var. *vernum* Reveal, var. nov. A var. *dichrocephalo* Gandg. differt perianthiis straminum vel luteus, (5-) 6-9 (-10) mm. longis, foliis var. *subarido* S. Stokes simulans, subglabris vel glabris, viridis. A var. *umbellato* differt statura major, plantis usque ad 0.6 (-0.9) m. altis et 0.9 (-1.3) m. latis, tholiformis.

Dome-shaped perennial shrubs 0.3-0.6 (-0.9) m. high and 0.3-0.9 (-1.3) m. across from highly branched, brown, woody caudices, these often making up more than half the plants' height; leaves whorled, restricted to the tips of elongated sterile shoots and the base of flowering stems, the leaf-blades elliptic, acutish, broadest near the middle or slightly above the middle, 1-2.5 cm. long, (3-) 5-9 mm. wide, slightly thickened along the margins in some, sparsely pubescent on both surfaces in early anthesis becoming less pubescent above during anthesis until nearly or totally glabrous on both surfaces in fruit; petioles ± narrowly winged, pubescent or glabrous depending upon the time of anthesis, up to 15 mm. long; flowering stems (5-) 8-15 cm. long, sparsely white floccose in early anthesis becoming glabrous and bright green during anthesis and early fruiting except for the very base, maturing brownish, the stems stout and somewhat rigid; bracts foliaceous, up to 1.5 cm. long, similar to the leaves only more reduced and sessile, usually reflexed; inflorescences up to 6 (-10) cm. long, 3-, mostly 4- to 5-rayed, the rays sparsely and thinly floccose becoming glabrous during anthesis in most, spreading; involucres campanulate, the tube 1.5-2.5 mm. long, the lobes 2-3 mm. long, reflexed, sparsely floccose, the numerous flowers long exserted on glabrous pedicels; perianth pale to bright yellow, (5-) 6-9 (-10) mm. long including the stipe, glabrous, the outer whorl of segments 4-6 mm. long, 2.5-5 mm. wide, broadly elliptical, the inner whorl of segments 5-8 mm. long, 3-4.5 mm. wide, spathulate; stamens included, becoming exserted during anthesis when the calyx-segments

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2. Work performed under Contract No. AT (04-1) Gen-12 between the University of California and the Division of Biology and Medicine, U. S. Atomic Energy Commission.

greenish, or yellowish-brown, 3.5-5 mm. long, distinctly 3-angled nearly the entire length; embryo green, straight.

TYPE.— NEVADA: Nye Co., Nevada Test Site, common in soils derived from light-colored volcanic rocks near the Yucca Flat - Forty-Mile Canyon drainage divide at the N end of Shoshone Mtn. along the Buckboard Mesa (or Tippipah Spring) Road, 0.3 mi. E of the divide and ca. 1 mi. W of Tippipah Spring, elevation 5450 feet, 4 June 1968, *James L. Reveal 1139*. Holotype deposited at UTC. Isotypes distributed to ARIZ, BRY, CAS, DS, GH, MO, NTS[3], NY, RSA, UC, US, UT, and other herbaria.

DISTRIBUTION.— Known only from near volcanic rock outcrops along the foothills of desert ranges from Shoshone Mtn. N to the S end of the Monitor Range, 5200-6500 feet elevation. Nye Co., Nevada. Flowering from May to early June.

SPECIMENS EXAMINED.— NEVADA: Nye Co., Cat Canyon, Timber Mtn., *Beatley & Bostick 5021* (BRY, NTS, NY, UTC), the ochroleucous-flowered form, *5023* (BRY, NTS, NY, UTC), the yellow-flowered form; canyon W of Tippipah Point, Shoshone Mtn., *Beatley 4533* (BRY, NTS); 1.5 mi. W of the Yucca Flat - Forty Mile Canyon drainage divide, N Shoshone Mtn., *Beatley 5666*, *5667*, *5668* (BRY, NTS); 28.5 mi. E of Tonopah, 5 mi. E of the Salisbury Flat turnoff, S. Monitor Range, *Reveal & Beatley 1118* (BRY, CAS, GH, NTS, NY, UC, US, UTC); near the top of Tippipah Point, Shoshone Mtn., *Reveal 1144* (BRY, CAS, NTS, NY, UC, US, UTC); White Blotch Springs, *Reveal 1351* (BRY, CAS, GH, MO, NTS, NY, RSA, UC, US, UTC); SE of Shoshone Peak, ca. 2.5 mi. SW of Mine Mtn. Junction, *Reveal 1380* (BRY, CAS, GH, NTS, NY, UC, US, UTC); Tippipah Spring, *Richards s.n.* (BRY).

The recognition of any new taxon in the *Eriogonum umbellatum* complex must be approached with considerable caution. Not only are the numerous varieties difficult to distinguish in some localities, there has not been a comprehensive review of the complex published as of yet. Over the last few years I have been able to study several of the critical type specimens and have been able to see many of the varieties in the field so that it is now possible to recognize over twenty-five different varieties in the species. While many problems remain to be solved, it is possible to recognize and describe the obviously distinct forms without the fear of having them already circumscribed under another name.

The various forms in the *Eriogonum umbellatum* complex in southern Nevada are rather distinctive and not normally subject to the kind of confusion one usually finds in this species, as in the Pacific Northwest for example. The large, spreading subshrubs with compound inflorescences and subglabrous leaves are called var. *subaridum* S. Stokes, while the forms of lower stature with more yellowish to reddish flowers with a tan midrib are known as var. *dichrocephalum* Gandg. (formerly known in the literature as var. *aridum* (Greene) C. L. Hitchc.). Those plants with reddish-brown to pink flowers having large reddish or purple midribs are called

3. NTS is used here to designate the Nevada Test Site Herbarium, Mercury, Nevada 89023.

var. *versicolor* S. Stokes. All of these plants normally flower from late June or early July through late September. The var. *vernum*, as the name implies, flowers in the spring of the year from May to early June. Likewise, none of these southern Nevada varieties has flowers as long as those found in var. *vernum*.

The var. *vernum* exhibits several interesting morphological features which are variously found in other forms of this species. The highly branched woody caudices are similar to the form of var. *umbellatum* typically seen along the eastern slopes of the Sierra Nevada and thus the plants are much more erect and woody than the low matted Rocky Mountain populations of var. *umbellatum*. The leaves of var. *vernum* are similar to those of var. *subaridum*, changing in the degree of pubescence as the growing season progresses. The large flower size is similar to that of vars. *polyanthum* (Benth. in DC.) M. E. Jones and *speciosum* (Drew) S. Stokes of northern California, but otherwise var. *vernum* is not closely related. Unlike most varieties, the new variety has two distinct and seemingly not intergrading color forms—one with bright sulfur-yellow flowers and the other with pale-yellow or ochroleucous flowers. In Cat Canyon, on the eastern side of Timber Mountain, the two grow together with the pale-flowered form much more common than the yellow-flowered form. On Shoshone Mountain, only the pale-yellow form has been found, as is the case for the White Blotch Springs population to the north. On the southern end of the Monitor Range, however, only the bright yellow-flowered form was found. The flowers of the pale-colored form are less persistent in fruit than those with the yellow color; in late June, most of the flowers have fallen from the plants in the first case while in the latter case, the yellow flowers containing mature fruit can still be found on the plants.

Of the various taxa in the species, the var. *vernum* is probably most closely related to var. *dichrocephalum* . In general, var. *dichrocephalum* on the Nevada Test Site (and elsewhere in its range) occurs at a higher elevation than var. *vernum*, but some plants in otherwise large populations of var. *dichrocephalum* have been seen in early anthesis in mid-June, and completely flowering plants are not uncommon in late June and early July. Thus, with the few common morphological features shared plus this characteristic of early flowering, it is possible to suggest this relationship.

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LACE BUGS COLLECTED DURING THE BREDIN-ARCHBOLD-SMITHSONIAN BIOLOGICAL SURVEY OF DOMINICA, B. W. I. (HEMIPTERA: TINGIDAE)

Richard C. Froeschner[1]

The recent Drake and Ruhoff "Catalog" (1965) contains no record of a lace bug from the Leeward island of Dominica. Therefore, it is of special significance to record the six species (two new to science) of five genera collected by members of the above survey.

Tabulation of the West Indies (excluding Trinidad) lace bug genera and species, including the two new ones described herein, reveals 49 species (*Caloloma uhleri* Drake and Bruner introduced from Australia) in 17 genera. Of these, 17 species in 10 genera are reported from the Lesser Antilles. This leaves on the Greater Antilles 7 additional genera not represented on the Lesser Antilles—further emphasis of the zoogeographic break between the two island groups.

Each of the five genera represented on Dominica belongs to the subfamily Tinginae and ranges from North to South America, in-

Zoogeographical Analysis of the Lace Bugs Occurring on Dominica

Genera with number of included species	Number of species on Dominica	Number of species known only from Dominica	Occurrence of these genera in Western Hemisphere: Antilles Lesser	Antilles Greater	South America	Central America	North America
Acanthocheila (17)	1	..	X	X	X	X	X
Corythucha (68)	1	..	X	X	X	X	X
Leptodictya (51)	1	1	X	X	X	X	X
Leptopharsa (109)	1	1	X	X	X	X	X
Teleonemia (85)	2	..	X	X	X	X	X
Total number genera	5						
Species	6	2					

1. Department of Entomology, Smithsonian Institution, Washington, D. C.

cluding the Greater Antilles. Therefore, their occurrence on Dominica did not come as a surprise.

This paper is based on specimens taken by various members of the survey who were kind enough to take time from their special interests to collect generally and make possible studies by those of us who did not join in the explorations. To these fellow entomologists I owe deep thanks: D. F. Bray; O. S. Flint, Jr., R. J. Gagne; D. L. Jackson; P. J. Spangler; W. W. Wirth. The study itself was aided in part by NSF Grant number GB-791 (96-M). The beautiful illustrations of these graceful and frail insects are by Elsie Herbold Froeschner.

Key to the Genera of Lace Bugs as They Occur on the Lesser Antilles

(genera in brackets not known from Dominica)

1. Pronotum anteriorly on midline with an elevated, swollen cyst (Fig. 4) 2

   Pronotum anteriorly on midline without a swollen cyst, sometimes with a tectate (roofshaped) low elevation 5

2. Anteromedian cyst of pronotum prolonged anteriorly, much surpassing apex of head (Fig. 4) 3

   Anteromedian cyst of pronotum short, subglobose, not exceeding apex of head 4

3. Elytra tumidly elevated near middle of basal third .... *Corythucha Stal*

   Elytra not tumidly elevated .....[*Corythaica Stal*]

4. Antennal segment I short, not longer than width of head between eyes ..... [*Caloloma* Drake and Bruner]

   Antennal segment I long, longer than width of head across both eyes ..... [*Phymacysta* Monte]

5. Side margins of paranota with prominent coarse spines (Fig. 1) ..... *Acanthocheila* Stal

   Side margins of paranota without spines 6

6. Paranotum projecting obliquely outward (never vertical nor lying on surface of pronotum), containing two or more rows of cells visible from above or below 9

   Paranotum either with one row of cells and placed vertically, or with several rows of cells and reflexed and lying on surface of pronotum 7

7. Paranotum vertical, containing a single row of cells ..... *Teleonemia* Costa

Paranotum with several rows of cells, reflexed against the surface of the pronotum 8

8. Scent gland canal distinctly elevated ..... *Leptodictya* Stal

Scent gland canal absent ..... [*Dictyla* Stal]

9. Outer margin of paranotum angularly expanded; costal area of elytron wide, with five or more rows of cells for most of its length ..... [*Gargaphia* Stal]

Outer margin of pronotum straight or convexly rounded; costal area of elytron narrow, with only two rows of cells on basal half or more 10

10. Head spine above bases of antennae very long, horizontal, reaching or surpassing apex of antennal segment I (Fig. 3) ..... *Leptopharsa* Stal

Head spine above bases of antennae very short, never reaching as far as midlength of antennal Segment I .... [*Vatiga* Drake and Hambleton]

Family Tingidae
Subfamily Tinginae
Genus *Acanthocheila* Stal

Monanthia (*Acanthocheila*) Stal 1858, p. 61.
Acanthocheila: Stal 1873, p. 127.

Acanthocheila thaumana Drake and Cobben
Figure 1

Acanthocheila thaumana Drake and Cobben 1960, pp. 67, 81.

This species was described from St. Eustatius and St. Martin at the north end of the chain of Leeward Islands.

The 15 specimens taken by W. W. Wirth during March at the mouth of the Layou River and at the Hillsborough estate extend the range to the southern limit of the Leeward Islands.

Genus *Leptodictya* Stal

Leptodictya Stal 1873, pp. 121, 127.

Leptodictya archboldi, n. sp.
Figure 2

Diagnosis.— The species of the subgenus *Hanuala*, to which this new one belongs, fall into several groups on the basis of color aspects. The present new species falls into the group where the dorsal appearance is fuscous with a large, oval, mediobasal area (occupying the clavi and broad adjacent parts of the coria) milky white. This gen-

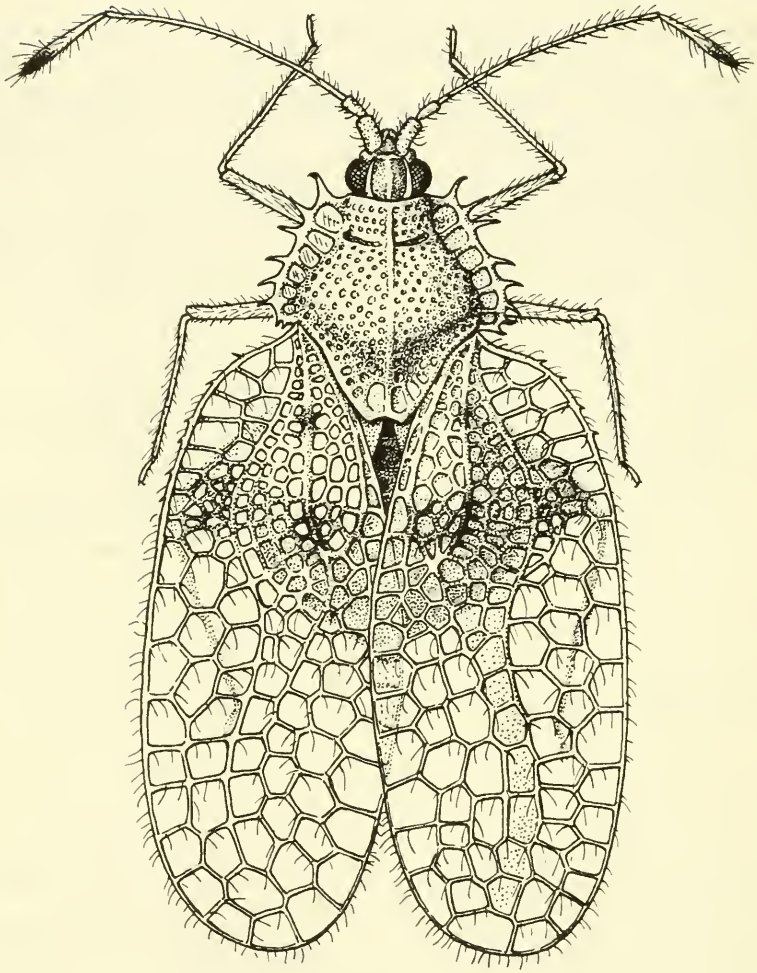

Fig. 1. Acanthocheila thaumana Drake and Cobben.

eral pattern results from a darkening of all the veins delimiting the hemelytral areas and the other veins (but not the cells) on the apical half and costal region of the corium; the veins in the mediobasal region are translucent milky white. Within this group, this new species can be recognized readily by the wholly shining black antennae plus the extremely long, mostly blackened head spines.

Description.— Holotype male. Length 3.6 mm., greatest width 1.8 mm. Head with five very long, erect spines: anterior pair reaching apex of antennal segment I, median spine and basal pair longer than the frontal pair, more than twice as long as horizotal length of an eye. Labium surpassing middle coxae.

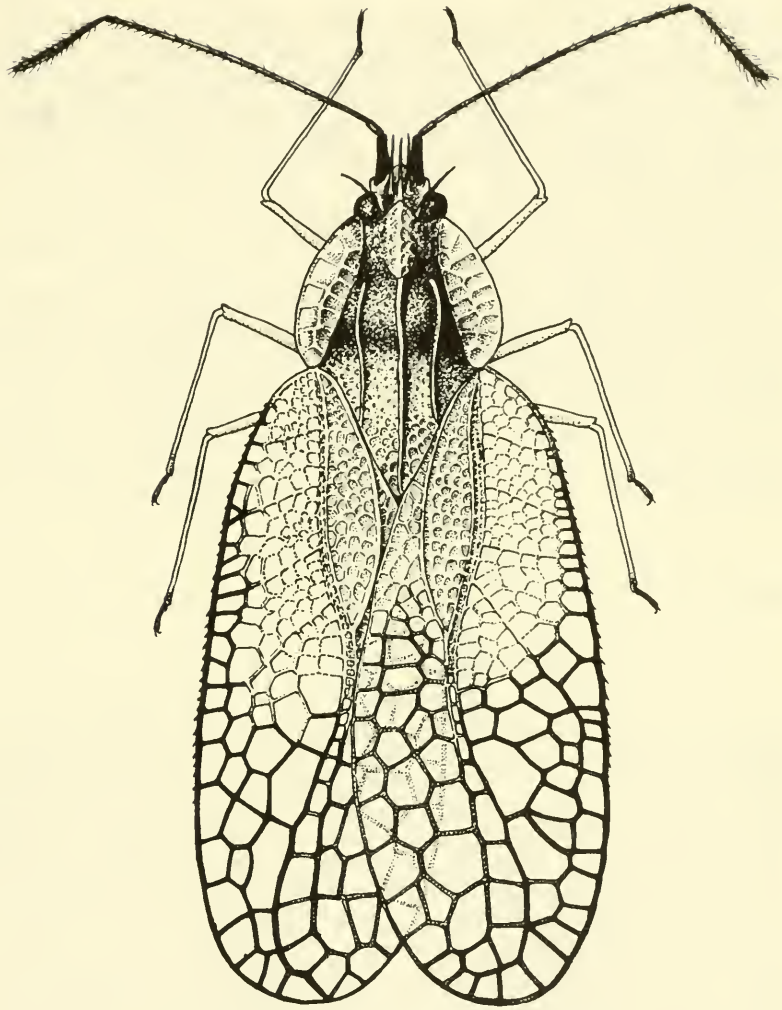

Fig. 2. Leptodictya archboldi, new species.

Pronotum tricarinate, each carina uniseriate except median where it is elevated as a multiareolated, compressotectate hood projecting into a short, acute angle over base of head. Paranotum expanded laterally, then suddenly and completely folded back over itself, the original free lateral edge now reaching the dorsal surface of the pronotum, the dorsally exposed surface biseriate; apical half of posterior projection milky white.

Hemelytra slightly widening posteriorly. Basal two-thirds of costal margin finely, distinctly serrate. Costal area broad, mostly abundantly, finely reticulate on basal half and with much coarser

reticulations on apical half; with four, slightly more prominent, oblique veins on basal half. Subcostal area very narrow, biseriate. Discoidal area elongate, narrowly fusiform, about five areole wide at widest point, there less than half as wide as costal area opposite to it; with a prominent, oblique, embrowned vein near middle. Sutural area wide, expanding toward apex. Hind wings slightly surpassing apex of abdomen.

Holotype male: Dominica, British West Indies, Morne Plat Pays, December 10, 1964, Paul J. Spangler, "in base of *Euterpe globosa* frond." (USNM type no. 70218).

Although this genus is essentially a tropical element, three species occur as far north as southern North America. Previously only one was reported for the West Indies (Puerto Rico and Cuba): the bamboo-frequenting form *bambusae* Drake which differs from the Dominican species by its wholly pale antennae and hemelytra.

The species is dedicated to Mr. John D. Archbold, a cosponsor of this biological survey of Dominica and a frequent supporter of scientific efforts.

Genus *Leptopharsa* Stal

Leptopharsa Stal 1873, pp. 122, 126.

Leptopharsa bredini, n. sp.

Figure 3

Diagnosis.— Within the genus, *unicarinata* Champion and the present new species are the only species with but one pronotal carina discally, the median one; all the other species also possess two lateral discal carinae. Several features separate the two species; but most conveniently, *unicarinata* has the median carina subequal in height and uniseriate for its full length behind the hood, while in *bredini* it is biseriate for a distance behind the hood where it forms an abrupt, nearly semicircular, dorsal projection and then becomes uniseriate.

Description.— Holotype female. Length 3.5 mm., greatest width, 1.6 mm. Color, including antennae and legs shining yellow brown; head (including most of buccclae), anterior and median acetabulae, broad, oblique band extending from tip of discoidal area posteriorly along subcostal area to apex of hemelytron, fuscous to black.

Head short, with three erect, very long spines (length more than twice horizontal diameter of eye): one above each eye and one at middle apex of vertex. Bucculae about as high as vertical diameter of eye, finely reticulate. Antennal segment I shorter than interocular space, about twice as long as segment II, segment III about five times as long as I - II, about three-and-a-half times as long as segment IV. Labium reaching base of metasternum.

Pronotum distinctly and closely punctate, becoming reticulate on posterior process; disc unicarinate, median carina as described above, its anterior hood high, strongly compressed, multiareolate, arising

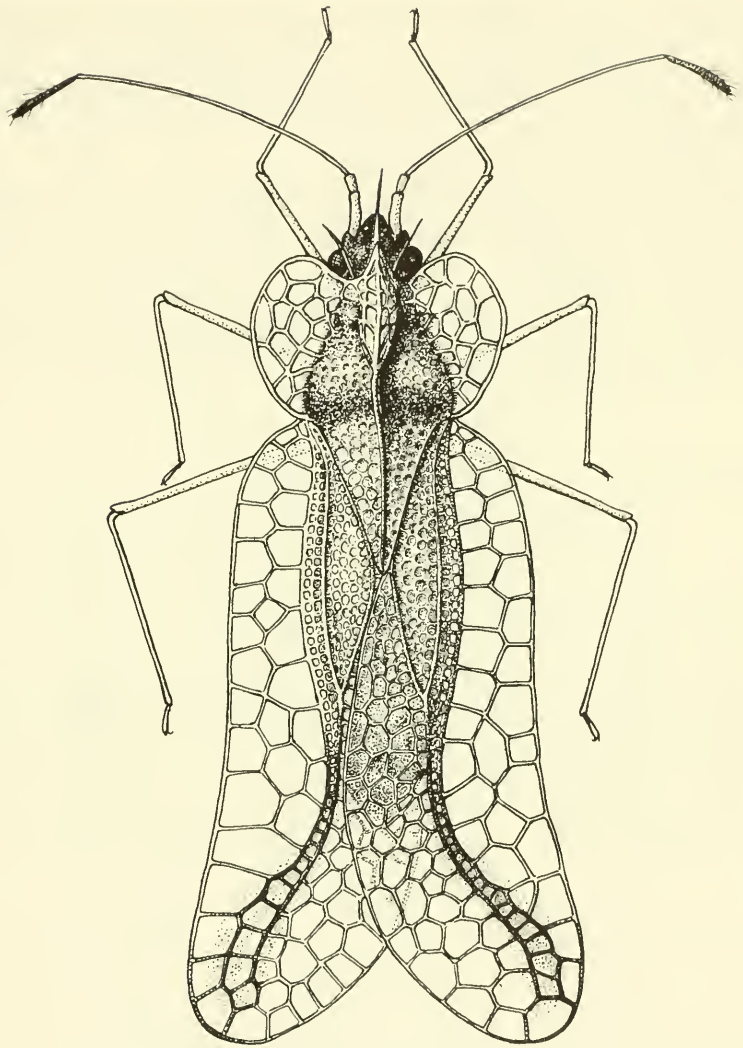

Fig. 3. Leptopharsa bredini, new species.

behind calli and extending forward over basal half of head. Paranota developed for full length, about four areolae wide, widest at mid-length, outer margin semicircularly convex. Hemelytra widening posteriorly, apices strongly divaricate; costal area very wide, with two rows of large, subquadrate arealoe from base to apex of discoidal area, three areolae in widest part; subcostal area narrow, with two rows of small areolae, vein between subcostal and discal areas very weakly tectate; discoidal area narrowly fusiform, reaching about to

midlength of hemelytron, four areolae wide; sutural area widening posteriorly, on apical half very wide, with four rows of large areolae.

Sternal laminae distinct on meso- and metasternum, uniseriate, parellel on mesosternum, strongly convex laterally and nearly touching posteriorly on metasternum. Hypocostal lamina uniseriate for full length. Legs long, slender.

Holotype female: Dominica, British West Indies, trail 1 mile north of junction of roads to Rosalie and Castle Bruce, April 23, 1966, 1,300 feet, R. J. Gagne (USNM type no. 70219). Paratype: Female, same island, Freshwater Lake, August 25, 1965, D. L. Jackson.

Mr. Bruce Bredin, cosponsor of the present Dominica project, has long been a supporter of scientific endeavors, including earlier Smithsonian explorations in the West Indies; I consider it a privilege to be able to dedicate this species to him.

Genus *Corythucha* Stal

Corythucha Stal 1873, p. 119, 122.

Corythucha gossypii (Fabricius)

Figure 4

Acanthia gossypii Fabricius 1794, p. 78.
Corythucha gossypii; Stal 1873, p. 123.

This widely ranging American species has been recorded from a great variety of hosts, including numerous cultivated crops. One extra-survey collection specimen was taken by J. Maldonado Capriles during July 1963 at St. Joseph.

Two series were collected by D. F. Bray: one lot of eight specimens from castor beans at Roseau on March 26 and another lot of three from squash at Southern Chiltern Estate on February 8.

Genus *Teleonemia* Costa

Teleonemia Costa 1864, p. 114.

Key to Species of Teleonemia on Dominica

1. Basal head spines long and tapering, in dorsal view reaching or surpassing upper margin of antennal sockets ..... *sacchari* (Fabricius)

   Basal head spines short, cylindrical, blunt, in dorsal view not reaching upper margin of antennal sockets ..... *prolixa* (Stal)

Teleonemia prolixa (Stal)

Laccometopus prolixius Stal 1858, 65.
Teleonemia prolixa; Stal 1873, p. 132.

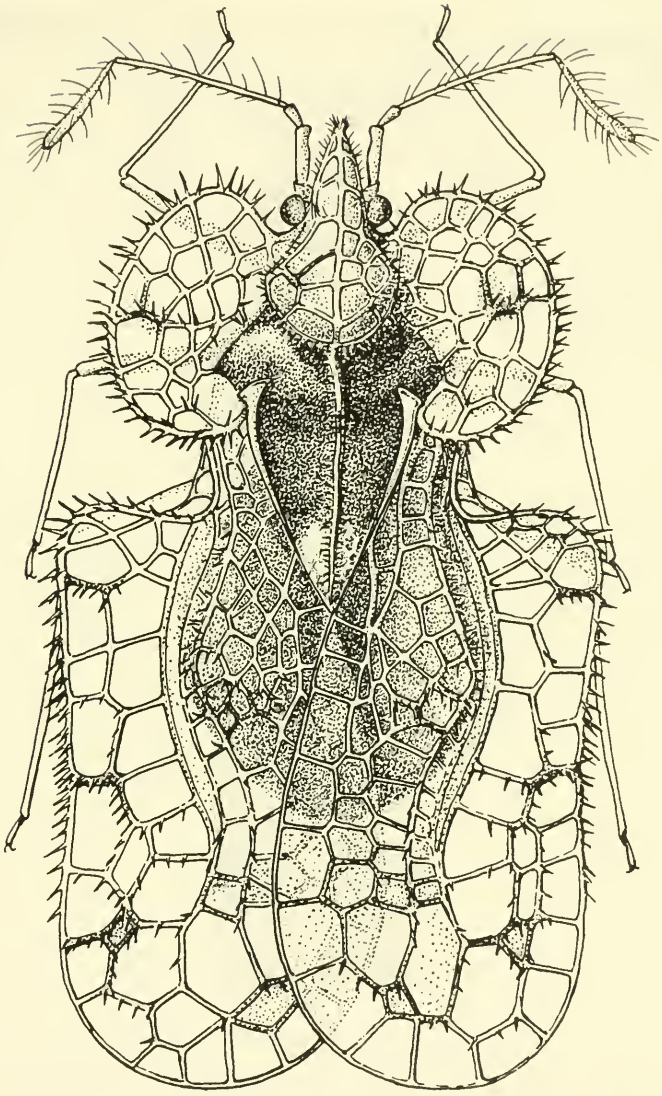

Fig. 4. Corythucha gossypii (Fabricius).

The few specimens from Dominica fall within the variations under this name in the Drake collection of lace bugs. Unfortunately, the extent of this variation far exceeds that shown by other species of the genus and involves tropical American material from widespread localities. Until *prolixa* is critically reviewed in a generic revision, the arrangement in the Drake collection is accepted as the standard of comparison and the name is being used here.

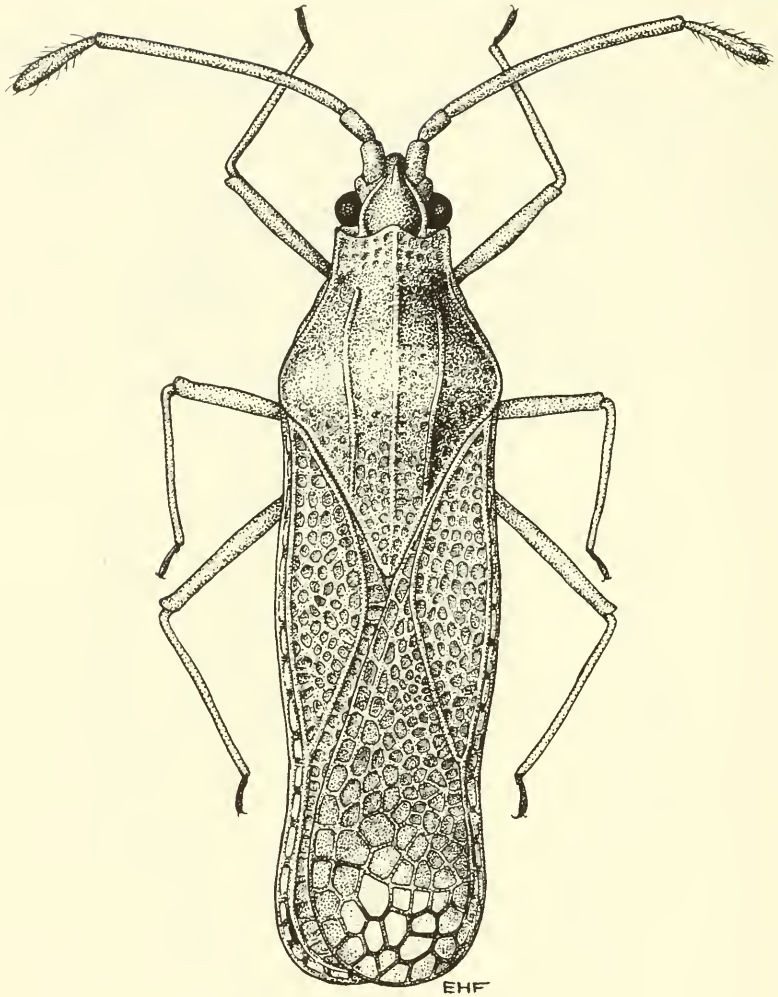

Fig. 5. Teleonemia sacchari (Fabricius).

Specimens taken at Benjamin, Clarke Hall and Grand Bay were colected during February, April, and September.

Teleonemia sacchari (Fabricius)
Figure 5

Acanthia sacchari Fabricius 1794, p. 77.
Teleonemia sacchari; Stal 1873, p. 132.

The present concept of this species is based on the very uniform series resting under this name in the C. J. Drake collection of lace

bugs. This concept does not agree with the captions and figures in lands Antilles. There, figure 79c with the short basal head spines is Drake and Cobben's (1960) paper on the lace bugs of the Nether- entitled *sacchari*. This is in contrast to the entire series of specimens mentioned above; these have the basal head spines long and tapering and reaching the dorsal margin of the antennal sockets.

This lantana frequenting species has been reported from the southern United States south through Central America and the West Indies to Brazil.

A pre-survey collection of this species on Dominica (without specific locality) was made by R. G. Fennah, July 3 and 12, 1941. Survey specimens were taken in March and September at Castle Comfort and La Fanchette.

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MEGEREMAEIDAE, A NEW FAMILY OF ORIBATID MITES (ACARI: CRYPTOSTIGMATA)[1]

Tyler A. Woolley[2] and Harold G. Higgins[3]

In 1965 we described *Megeremaeus* as a new genus of oribatids from Oregon, Washington, and Wyoming. We tentatively placed the mites in the family Eremaeidae, but qualified the placement as one of general affinity only. Since the mites were larger than any known Eremaeidae, with heavier, robust notogastral setae and distinctive knobs at the anterior margin of the hysterosoma, we assumed they were allied to, but not definitely included in the Eremaeidae. We mentioned that individual variations were evident in the relatively small sample of specimens studied and explained the differences in the appearance of certain of the structures, depending on the angle from which the specimen was viewed.

Additional specimens of *Megeremaeus* have been collected and studied since our original paper. Among them is a new species that is different from the generic type. We have compared both *M. montanus* and the new species with *Eremaeus* and *Tricheremaeus* and others of the general complex. We conclude that the characteristics are such that a new family should be erected for the genus and the two species included.

Megeremaeidae, fam. nov.

Body and legs covered with cerotegument; color dark reddish brown, nearly black in some specimens; lamellae rugose ridges with short, cylindrical cusps; lamellar hairs barbed, inserted in distal ends of lamellar cusps; tutoria rugose ridges, shorter than lamellae interrupted by a gap and followed posteriorly by a rounded knob; interlamellar hairs finely barbed and setiform or clubbed and barbed, inserted medial to but close to pseudostigmata; pseudostigmata cup-like, rounded sclerotized rim elevated above surface of prodorsum; sensillus clavate, head barbed, rounded or attenuated; dorsosejugal suture sclerotized, with two prominent knobs at shoulders; hysterosoma with ten pairs of barbed setae, some flattened and lanceolate; pseudoporosae anterior to setae r_1; each genital cover with six hairs; two or three pairs of anal setae; trochanters III, IV with large, sharp, dorsal spine; tarsi slightly heterotridactylous, median claw stoutest of the three.

The new family differs prominently from Eremaeidae in size (Megeremaeidae: length 1068-858μ X width 678-570μ; Eremaeidae: length 850-390μ X width 500-186μ). Eremaeidae are elongated in shape, not rounded; Megeremaeidae have a distinctly rounded hysterosoma, nearly as wide as long. Megeremaeidae are darker in

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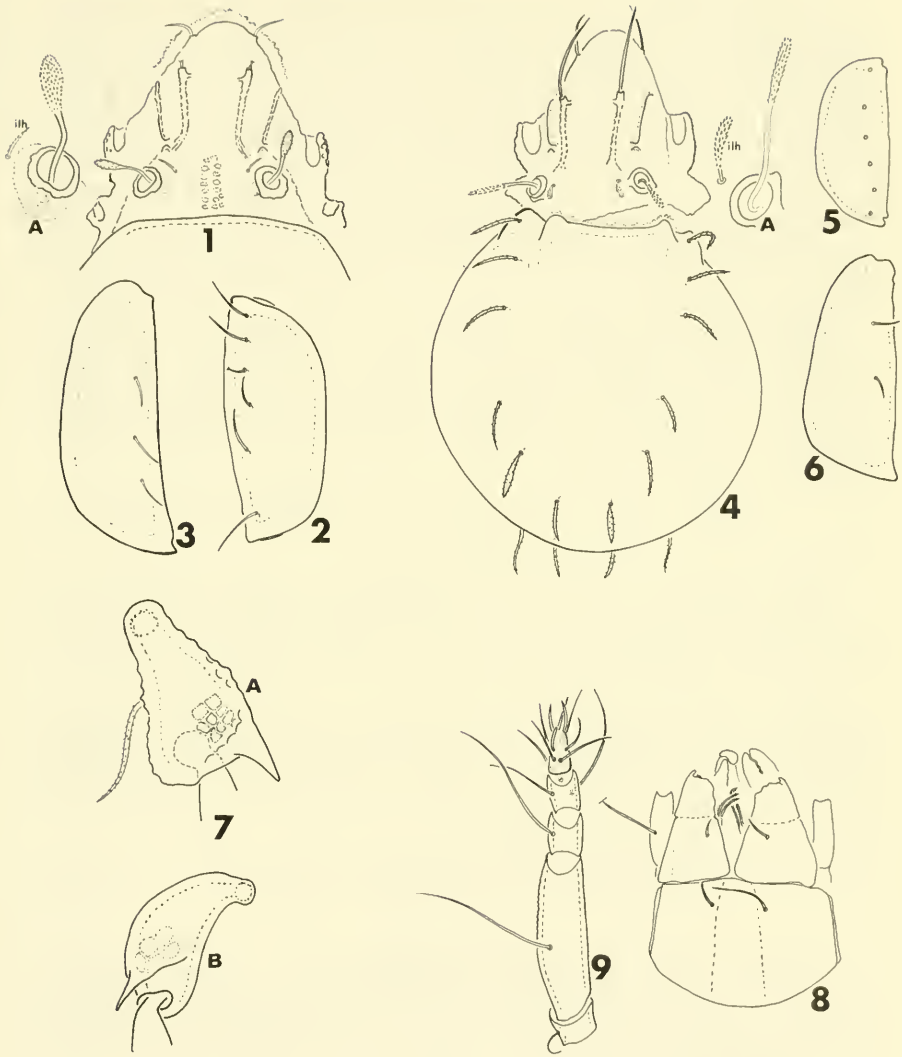

Fig. 1. Prodorsum of *Megeremacus montanus;* A, enlarged view of sensillus, pseudostigmata and interlamellar hair.
Fig. 2. Genital cover of same.
Fig. 3. Anal cover of same showing three anal hairs.
Fig. 4. Dorsum of *Megeremaeus ditrichosus*, legs omitted; A, enlarged view of sensillus, pseudostigmata and interlammelar hair.
Fig. 5. Genital cover of same.
Fig. 6. Anal cover of same showing two anal hairs.
Fig. 7. Trochanteral spines from dissected specimen of *M. ditrichosus*. A, trochanter IV, B, trochanter III.
Fig. 8. Infracapitulum of *M. Ditrichosus.*
Fig. 9. Palp of same.

color, reddish-brown to black where Eremaeidae tend to dark brown and tan shades. Megeremaeidae has 10 pairs of notogastral setae, Eremaeidae 10 or 11 pairs. Megeremaidae exhibit 2-3 pairs of anal hairs. Eremaeidae 2-9 pairs. Eremaeidae may or may not show a postanal piece; no postanal piece is present in Megeremaeidae. The tibial solenidia of leg I of Eremaeidae are stalked, the trochanters may or may not be keeled; Megeremaeidae show relatively little tubercle at the base of solenidia of tibiae I, all legs are without keels, but trochanters III and IV have prominent dorsal spines (but small spines are also found on femora III and IV of Eremaeidae) and all legs exhibit cerotegument; the setae of the legs of Megeremaeidae are robust, long and barbed.

Balogh (1965) listed characteristics of Eremaeidae and Piffl (1965) made a diagnosis of the family, but the characterizations have been extended by Higgins (research in progress). The details disclosed in this latter research have been in part the basis for the above comparison of Eremaeidae and Megeremaeidae and the designation of the new family.

Megeremaeus montanus Higgins and Woolley, 1965

(Figs. 1-3)

The distinctive differences between this species and the new species described below are the slight lamellar hairs, the type of sensillus and the three pairs of anal setae. We have added some figures to aid in the comparison of these species.

New collections should also be noted for this species. Four specimens, 2 male and 2 females were collected at Nahcotta, Washington, 20 September 1957 by T. Kincaid; six specimens, 5 females and 1 male, were collected near the summit of Snoqualmie Pass, Washington, 27 June 1968 by H. Higgins.

Megeremaeus ditrichosus, n. sp.

(Figs. 4-9)

Diagnosis.— The new species differs from *M. montanus* in having robust, barbed, clavate interlamellar hairs, a more attenuated, barbed sensillus and two pairs of anal hairs. The trivial name is constructed from the Greek *di-* and *trichos* to designate the distinctive feature of the anal setae.

Description.— Color dark reddish-brown covered with cerotegument; rostrum rounded, rostral hairs about half as long as lamellar hairs, slightly barbed, inserted in short tubercles posterior to rostral tip; lamellae rugose ridges in middle of prodorsum, curved laterally at posterior tips and reduced in height, lamellar cusps short, cylindrical; lamellar hairs about a third longer than rostral hairs, slightly curved, barbed, inserted in distal tips of lamellar cusps; translamella partial, interrupted medially, consisting of short, sclerotized bar extended medially from base of lamellar cusp; tutoria shorter than lamellae, rugose ridges parallel to lamellae, interrupted posteriorly

and with a rounded knob-like projection between tutorium and pseudostigmata; interlamellar hairs about as long as width of pseudostigmatic opening, robust, rounded tips, clavate, barbed, inserted about half their lengths from medial aspect of pseudostigmata; pseudostigmata raised above surface of prodorsum, rounded, cup-like; sensillus about as long as rostral hairs, attenuated, barbed; pedotecta I roughened at about level of tutoria, pedotecta II shorter and more angular than pedotecta I (Fig. 4).

Anterior margins of hysterosoma with two sclerotized knobs at each shoulder, median pair more robust; 10 pairs of barbed, elongate notogastral setae (Fig. 4).

Camerostome elongate; infracapitulum as in Fig. 8; genital aperture nearly rounded, each genital cover with six setae (Fig. 5); adanal setae inserted laterally at level about middle of genital opening; anal opening more elongate than genital, each anal cover with two setae (Fig. 6), three pairs of adanal seate, fissure *iad* near margin of anal opening near anterior end.

Legs heterotridactylous, the median claw only slightly larger than lateral claws; trochanters III, IV with strong dorsal spine; leg setae long, barbed.

Measurements.— The range of measurements for the specimens we have of this species is taken in part from dissected forms in which the dorsal plate has been removed.

Length, 930-858μ; hysterosoma 582-606μ; prodorsum 330-276μ.

Width: 618-570μ.

Collections.— The type, a female, and 4 paratypes, 2 females, 1 male and 1 dissected specimen of undetermined sex, were collected near the top of Mary's Peak, Benton Co., Oregon, 31 July 1962, by T. A. Woolley.

Discussion.— Even though the number of specimens we have observed is small, we are of the opinion that this new family, Megeremaeidae, is a distinctly different group of oribatid mites. The single genus, and the two species included in it, are also distinctive.

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A NEW SPECIES OF *SPHODROCEPHEUS* FROM THE WESTERN U. S.[1] (ACARI: CRYPTOSTIGMATA, CEPHEIDAE)

Tyler A. Woolley[2] and Harold G. Higgins[3]

In a previous paper (Woolley and Higgins, 1963) we delineated the characteristics of the family Cepheidae, some of the synonymy involved with certain genera and described a new genus and species. Collections since that time have disclosed further examples of *Sphodrocepheus tridactylus* and a new species within the genus. These new distributional records are included below with the diagnosis and description of a new species.

Sphodrocepheus tridactylus W. & H., 1963

Three male specimens of this species were collected in moss, four miles south of Waldport, Lincoln Co., Oregon, by G. Krantz and J. D. Lattin, 7 February 1960. Very little variation was noticed between these specimens and those previously collected. This record extends the distributional range of the species in Oregon.

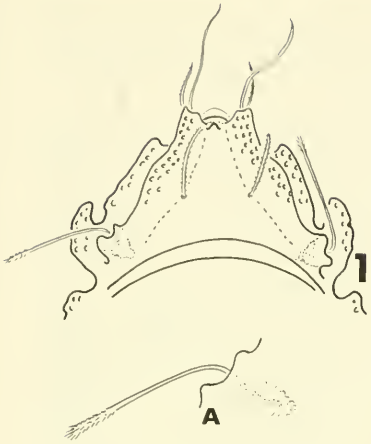
Sphodrocepheus anthelionus, sp. n.

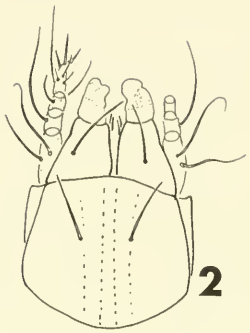
(Figs. 1-5)

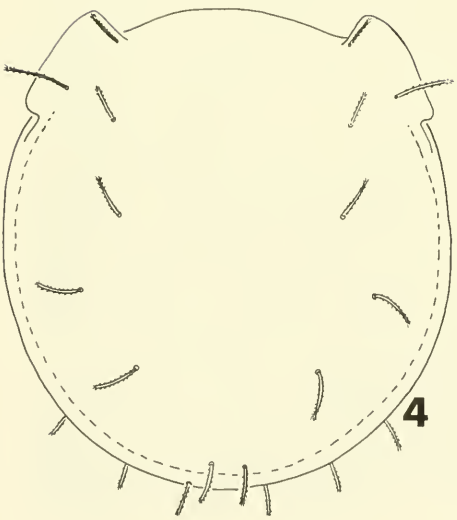
Diagnosis.— The new species differs from *S. tridactylus* in its larger size, in the shorter, tufted sensilli (Fig. 1A) and notogastral hairs (Fig. 4). The new species also exhibits differences in the lengths of the prodorsal hairs but is particularly contrasted to *S. tridactylus* in the presence of a translamella and slight mucro posterior to it; the new species has two humeral bristles instead of one as in *tridactylus;* other minor differences are included in the description below. The trivial name is derived from the Greek, *anthelionos*, a diminutive of "plume of a reed" and has specific reference to the plumed tips of the sensillus and notogastral hairs.

Description.— Color dark brown; prodorsum broadly triangular; rostrum rounded, rostral hairs shorter than lamella hairs, curved, slightly barbed, inserted in margins of rostrum posterior to tip; lamellae narrowed, with sinuate lateral margins, pitted, lamellar cusps narrower than lamellae, with slight dentes at anterolateral corner; lamellar hairs twice as long as interlamellar hairs, sinuous and serpentine in appearance, smooth, inserted in distal ends of lamellar cusps; interlamellar hairs longer than rostral hairs, but shorter than lamellar hairs, barbed, with slightly plumed ends, inserted at middle of length of lamellae; tutoria prominent flanges at lateral margins of prodorsum, pitted, confluent with anterior margin of pedotecta I; surface of prodorsum between lamellae smooth, not pitted as are lamellae and tutoria; pseudostigmata cup-shaped, with robust circu-

1. Research supported in part by TG-TOI-A-1000095-09 NIH-NIAID.
2. Department of Zoology, Colorado State University, Fort Collins.
3. Participant in Research Participation for High School Teachers Program, Colorado State University, Summer 1968.







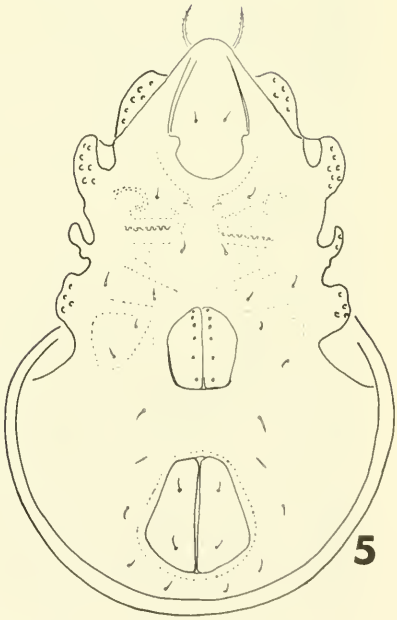


Fig. 1. Prodorsum of *Sphodrocepheus anthelionus;* A, enlarged view of pseudostigmata and tufted sensillus.
Fig. 2. Infarcapitulum of *S. anthelionus* from the ventral view.
Fig. 3. Enlarged view of humeral process and bristles of *S. anthelionus.*
Fig. 4. Dissected dorsal plate of *S. anthelionus*, showing notogastral bristles.
Fig. 5. Venter of *S. anthelionus*, legs omitted.

lar, raised margin, wide, open cup internally; sensillus longer than interlamellar hairs, tufted at distal tip (Figs. 1, 1A); pedotecta I large, robust, pedotecta II smaller, surfaces pitted similarly to lamellae and tutoria.

Hysterosoma smooth, nearly circular in outline, with roughened, sclerotized humeral processes at shoulders, pits, apodemes and shoulder bristles as in Figs. 1, 3; ten pairs of tufted, barbed notogastral setae (Fig. 4) anterior humeral seta not as long as width of shoulder, posterior humeral hair about a fourth longer, closer in length to other notogastral setae (Fig. 4; humeral processes rough, sclerotized, with large pits and sclerotized external apodemes (Fig. 3).

Camerostome ovoid, with lateral articulating condyles; infracapitulum as in Fig. 2; rutella with scoop-like membranous tips, rutellar teeth dorsal to membranous structures; palp, genal and mental setae as in figures; palp tarsus with three acanthions at distal end; apodemata and ventral setae as in Fig. 5; apodemata II with transverse, serrated, external ridge; genital opening elongated, each cover with six setae; aggenital setae posterior and lateral; anal opening about a fourth larger than genital, more elongated, each anal cover with two setae; fissure *iad* obliquely angled and remote from anterior margin of anal opening by about three times its length; adanal setae as in Fig. 5.

Legs heterotridactylous, medial claw larger and heaver than laterals.

Measurements.— The dissected type specimen is 870μ long and 624μ wide; prodorsum is 234μ long.

Collection Data.— The type specimen, a female, was collected from moss, near the summit of Snoqualmie Pass, Washington, 27 June 1968, by H. Higgins; seven additional specimens (5 males, 2 females) from Washington were collected near Easton, 27 June 1968, by H. G. Higgins. Two females were collected near Suttle Lake, Deschutes National Forest, Oregon, Mar. (?) 1965, by W. B. Grabowski; one male specimen was taken from moss on rotting log, near Spirit Lake, Uintah Mountains, Utah, 7 August 1963, by H. G. Higgins; one female specimen was taken under conifers near Vancouver, B. C., 9 June 1962, by H. G. Higgins.

Discussion.— The most striking differences between this species and *S. tridactylus* are in the lengths of the various hairs. In *tridactylus* the interlamellar hairs are longest of the prodorsal hairs, the rostral hairs shortest and lamellar hairs intermediate. In *S. anthelionus* the lamellar hairs are longest, the interlamellar hairs intermediate and the rostral hairs shortest.

The notogastral setae in the new species are shorter than in *S. tridactylus*, but are also finely barbed on the shaft of the hair and tufted at the tips; the new species also has two humeral bristles where *S. tridactylus* exhibits only one.

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A NEW MITE OF THE GENUS *EUPTEROTEGAEUS* FROM OREGON[1] (CRYPTOSTIGMATA: CEPHEIDAE)

Harold G. Higgins[2] and Tyler A. Woolley[3]

During a recent collecting trip into the northwestern part of the United States, many unusual mites were found. Among these was a new species of moss mite of the genus *Eupterotegaeus*. This now brings the number of species recorded from the United States to three, and all have been found in the states of Colorado, Utah, Washington and now Oregon. A description of this new species follows below.

Eupterotegaeus rhamphosus, n. sp.

Diagnosis.— Rostrum rounded, with out median spine; lamellae large, projecting over rostrum, with broadly rounded lateral margins and sharp "beak-like" inner margins; a triangular projection mediad to pteromorphae along dorsosejugal suture: differing from *E. spinatus* in the lack of translamellar spine and from *E. rostratus* in the rounded rostrum and sharply pointed lamellar cusps, and from both in having a projection mediad of humeral processes on dorsosejugal suture and all legs monodactylous. The trivial name comes from the Greek meaning "curving beak" and refers to the sharply pointed lamellar cusps.

Description.— Dark reddish-brown color; prodorsum about two-thirds as long as hysterosoma and approximately as long as broad; rostrum rounded with small lateral projections; rostral hairs simple, inserted in anterolateral margins of rostrum; lamellae over three times as long as broad of nearly equal width throughout, lamellar cusps ending in sharp incurved anterior medial tips resembling a beak; lamellar hairs simple, as long as width of lamellae, incurved, extended beyond tip of lamellae and inserted near anterolateral edge; interlamellar hairs missing in type specimen, their insertions mediad of pseudostigmata; pseudostigmata heavy, cup-shaped, with roughened edges, directed anterolaterally; sensillus club-shaped, shorter than the distance between the pseudostigmata, about twice as long as lamellar hairs, with a finely setose tip; no exobothridial hairs observed on type specimen.

Hysterosoma rounded, with roughened anterolateral pteromorphs projected anteriorly; a triangular projection mediad of pteromorphs along dorsosejugal suture; surface with a light rectangular pattern; nine pairs of short, marginal setae observed, each seta set on a raised tubercle; areae porosae or muscle attachment scars along lateral margins of hysterosoma (Fig. 1).

1. Research supported in part by TG-TOI-A1000094-09 NIH-NIAID.
2. Participant in NSF Research Participation for High School Teachers Program, Colorado State University, 1968.
3. Colorado State University, Fort Collins, Colorado.

Camerostome egg-shaped, with setae as shown in Fig. 2; a heavy, exposed apodeme projecting laterad at level of pedotecta I; ventral setae as shown in Fig. 2; genital aperture with flattened sides, trapezoidal, about as broad as long, each genital cover with six hairs; anal aperture egg-shaped, about one-third longer than genital aperture and separated from genital opening by about one-half its length, each

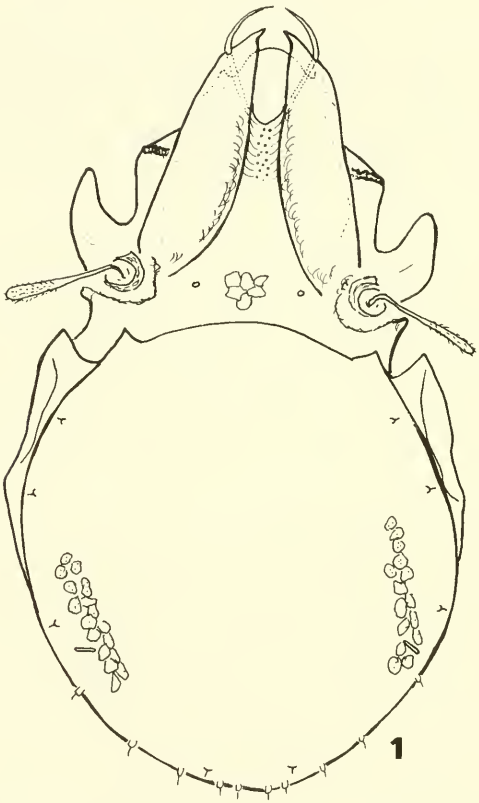

Fig. 1. *Eupterotegaeus rhamphosus*, from the dorsal aspect, legs omitted.

cover with two setae; preanal piece prominent; aggenital setae inserted remotely from genital aperture, at level midway between genital and anal apertures; three pairs of adanals observed on type specimen, ada: 1, 2 posterior to anal aperture, ada: 3 inserted laterad of cover at level near middle of anal plate; *iad* fissure located between aggenital setae and ada: 3 at level of anterior edge of anal plate.

Entire body and legs covered with a cerotegument. All legs monodactylous, contrasting to tridactylous legs of *E. rostratus* and *E. spinatus*. Size: Length 396μ; width 232μ.

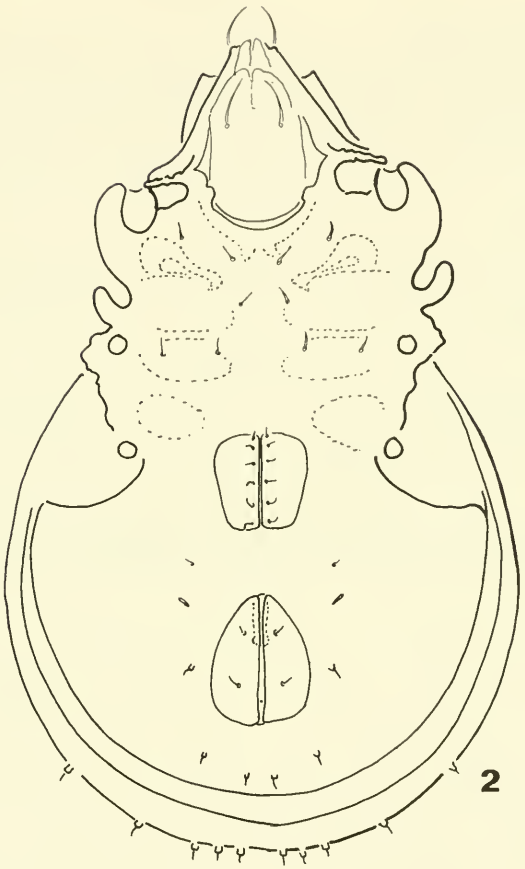

Fig. 2. Venter of *E. rhamphosus*, legs omitted.

The type specimen, a male, was collected by H. Higgins from moss along stream, 10 miles south of La Grande, Union Co., Oregon. 26 June 1968. This type specimen is broken and the drawings are partly reconstructions. The type was deposited in the U. S. National Museum.

Key to the Species of Eupterotegaeus

1. Lamellae rather narrow toward distal half with "shoe-shaped" apices ..... *E. ornatissimus* (Berlese)
   Lamellae broader, with nearly parallel sides 2

2. Legs monodactylous; a triangular projection mediad of pteromorphs along dorsosejugal suture .....
   ..... *E. rhamphosus* Higgins & Woolley

Legs heterotridactylous; no triangular projection mediad of pteromorphs 3

3. Prodorsum with a distinct translamella ..... *E. spinatus* Higgins & Woolley

Prodorsum without a translamella ..... *E. rostratus* Higgins & Woolley

Discussion.— In our previous paper (1963) on this genus we inadevertently did not catch a spelling error in the generic name. We spelled it *Eupterotegeus*, which is incorrect and should be written *Eupterotegaeus*.

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THE SYSTEMATICS OF *CROTAPHYTUS WISLIZENI*, THE LEOPARD LIZARDS (SAURIA: IGUANIDAE). PART II. A REVIEW OF THE STATUS OF THE BAJA CALIFORNIA PENINSULAR POPULATIONS AND A DESCRIPTION OF A NEW SUBSPECIES FROM CEDROS ISLAND[1]

Benjamin H. Banta[2] and Wilmer W. Tanner[3]

This is the second of a planned series of studies on the systematics of the leopard lizards, *Crotaphytus wislizeni*. We have previously described the populations inhabiting the Upper Colorado River Basin of southeastern Utah and adjacent states, and the population of *Crotaphytus wislizeni wislizeni* in Arizona, New Mexico, Texas, and northern Mexico (Tanner and Banta, 1963). A study of the Great Basin populations has been underway for some time, and will appear as Part III.

For the loan of, or opportunity to examine specimens under their care which were essential for use in this study, the authors wish to thank Dr. Richard Etheridge, and Mr. Allan J. Sloan, San Diego Natural History Museum (SDNHM); Dr. Robert Inger, Chicago Natural History Museum (CNHM); Dr. James Peters, United States National Museum (USNM); Drs. Alan E. Leviton and Steven C. Anderson, California Academy of Sciences (CAS); Dr. Richard B. Loomis, California State College at Long Beach (LBSC); Dr. George S. Myers, Stanford University (SU); Dr. Kenneth S. Norris, University of California at Los Angeles (UCLA); Dr. Robert C. Stebbins, University of California at Berkeley (MVZ); Dr. Ernest E. Williams, Harvard University (MCZ); Dr. Richard G. Zweifel, American Museum of Natural History (AMNH); Dr. T. Paul Maslin, University of Colorado Museum (CU); and Brigham Young University (BYU).

THE STATUS OF THE BAJA CALIFORNIA LEOPARD LIZARD POPULATIONS

Leopard lizards from the southern Baja California peninsula were described as *Crotaphytus copeii* by Yarrow in 1882, based upon a specimen obtained by Lyman Belding at La Paz, Lower California, in 1882. Stejneger and Barbour (1917) recognized *C. copeii* as did Dickerson (1917). However, Van Denburgh (1922) was "unable to find any differences between specimens from Cerros (=Cedros) and Magdalena Islands, Lower California (*C. copeii*), and those from the United States, either in color or proportions." Schmidt (1922) also argued against recognizing *C. copeii* stating that, "The

1. This work was partially supported in its initial stages by a grant from the Johnson Fund of the American Philosophical Society.
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specimens secured by the Albatross Expedition (1911), one each on Cedros and Tiburon Islands, are certainly insufficient to establish the validity of *C. copeii*, much less of insular races, in view of the greater variability of typical *wislizenii*." Schmidt added, however, that a "larger series from the peninsula may re-establish *C. copeii*."

Although there is still a need for additional specimens from both peninsular and insular Baja California, we believe that there are now adequate samples to provide at least a basic preview of the systematic status for such populations as do occur on Cedros Island and Peninsula Baja California. Leviton and Banta (1964) recognized the Baja California leopard lizards as *Crotaphytus wislizeni copei* Yarrow, based upon preliminary analysis of specimens in the California Academy of Sciences collections, a status which we wish to support further. In the following account all measurements are in millimeters.

Crotaphytus wislizeni copei Yarrow, 1882

Type: USNM 12663 (see figures 1 and 2).

Type Locality: La Paz, Baja California Sur, Mexico.

Original Description: By Yarrow, 1882. Since the original description is brief and not readily available, we offer it in its entirety:

"Description: Head broader and longer than *C. wislizeni*. Superciliary ridges well developed. Anterior border of auditory aperture with one, two or three larger scales than the surrounding ones. Scales anterior to orbits, and posterior to nostrils, on upper surface of head, larger than elsewhere. Scales on gular larger than those anteriorly or posteriorly. Upper and lower labials fifteen each to angle near base of jaw. Infraorbital chain consists of four plates, the second very large. Femoral pores large and distinct. First phalanx of hind leg extended reaches angle of jaw. Color dark gray, maculated with dark brown circular spots, each having a lighter center. Anterior to the lower extremities the spots become rhomboid in shape, and on the tail are oval. The head is densely and minutely punctulated with black spots. Belly white. This species is to be compared with *C. wislizeni*, from which it differs in certain particulars, the coloration being entirely different from any of the known species of *Crotophytus* (sic.)."

As noted above, the original designation of these southern populations was based primarily on the color and color pattern. To these characters we may now add: 1. an increased number of femoral pores; 2. one or usually no small scales entering pores posteriorly (in some few specimens there are two scales which enter some, but not all pores); 3. a proportionately longer tail, especially ratio of tail to total length is greater (.68 to .71). There is also a lower average of postmentals (3.6); however, most specimens have four and are thus similar to mainland *C. wislizeni*.

Re-description of the Type: A young adult female, snout vent length 83, tail regenerated with 70 comprising the non-regenerated

Figure 1. Dorsal view of holotype of *Crotaphytus wislizeni copeii* Yarrow [USNM 12663] from La Paz, Baja California Sur, Mexico. Photograph by Dr. Alan E. Leviton, June 1961.

Figure 2. Ventral view of holotype of *Crotaphytus wislizeni copeii* Yarrow. Photograph by Dr. Alan E. Leviton, June 1961.

portion and 67 the regenerated region. Head distinct, orbit to rostral 9.4, orbit to ear 6.5, rostral to ear opening 20.8, head width 15.4, head depth 10.7. Appendages well developed, length of right foreleg 33, length of right hindleg 72, length of longest toe, 30. Dorsal scales (occiput to base of tail) 219, dorsomedial head scales (occiput to and including rostral) 24, ventromedial body scales 100, ventromedial head scales (including mental) 67, nuchals approximately 9 in number and cream in color. Supralabials 23/24, infralabials 16/17, femoral pores 24/24. Postmentals 2/1 (3), internasals 7, postrostrals 3-1-3, scales between rostral and nasals 2-2. Dorsal pattern distinct, dorsal transverse bars wide, light tan, 8 in number, and do not extend laterally. Dorsal spots brown and bounded by white. Dorsum color light tan, dorsal blotching consists of olive brown spots with two, three and sometimes four components bordered by small white spots. On the anterior portion of the body these brown spots have a small white circle center, a somewhat comparable pattern also occurring on the anterior portion of the tail. Numerous brown spots on head dorsum. Only five faint gray gular stripes (3-6 scales wide) are present with two transverse connections anteriorly. Venter cream with small dark specks present in the pectoral region.

Material Examined: (N=50) MEXICO: Baja California: 6 mi. W Alaska (MVZ 31839), 3 mi W Canon de Llanos, ± 10 mi SW Alaska (MVZ 31794-5), Punta San Felipe (MVZ 50017), El Cajon Canon (MVZ 9589), El Medano (MVZ 1350-1), Medano Blanco (MVZ 37260-1), Turtle Bay (MVZ 45584), 30 mi SE Mesquital (MVZ 50018), 3 mi SSE El Arco (MVZ 50020), 20 mi SSE El Arco (MVZ 50019), 0.5 mi SE San Jose de Gracia (MVZ 73569), near

Bahia Asuncion (CNHM 130299-300), sand dunes, 12 mi SE Venancio (MVZ 37362), 4 mi E Punta Santa Rosalia (AMNH 75762), Vizcaino Desert, 8 mi SE Rancho La Cantina (CAS 90297), Rancho San Jose (CAS 65857-60), 15 mi W El Rosario (BYU 21781), Cadeje (BYU 21783), Mountains N Baja California (USNM 16856), Ensenada (USNM 37629), Yubay (USNM 37630), San Quintin (CNHM 1124), San Jorge (SU 18823), San Tomas (SU 1087), 5 mi W El Marmol (SU 11547), San Telmo River at San Jose (SDNHM 4071), 3 mi E Socorro (SDNHM 4143), San Jose (SDNHM 5078-80, 26752-3), 12 mi E El Arco (SDNHM 17470), Rancho Buena Vista, 7 mi NW San Jose (SMNHM 36454), 2 mi N San Simon (SDNHM 42622), Valle de Trinidad (SDNHM 18945-6), 8 mi E El Rosario (SDNHM 43007), 40 mi W Bahia de Los Angeles (SDNHM 19787), Bahia de San Francisquito (SDNHM 18118), no specific localities (MCZ 14302-3), La Paz (USNM 12663), 6 mi W Rancho Catavina (LBSC 1470).

Diagnosis: A peninsular population of *Crotaphytus wislizeni* differing from mainland Mexico and United States populations in a conspicuous dorsal pattern, not variable brown spots surrounded by small white spots, but with brown spots broken up into smaller components of two to four parts, each bordered by small white spots. Available samples provide some extent of the parameters of variation of the following meristic characters: 1) number of body ventrals: 44(96.0454)86-108[1], 2) number of mediodorsal scales (occiput to base of tail): 43(199.0465)174-277, 3) ventrals into head: 42 (63.3571)55-73, 4) number of femoral pores: 44(45.75) 38-53. The morphometric variation of the peninsula population is as follows: 1) snout-vent length: 46(94.4565)48-121, 2) tail length: 41 (218.6341)104-253, 3) head length: 46(24.1531)13-33, 4) head width: 45(17.7826)10-23, 5) snout length: 46(10.8043)6-14.

That the dorsal blotches begin as single units and diverge into 2-4 subunits may be discerned by an examination of a juvenile specimen (Fig. 3).

Range: Most of the Baja California peninsula except the coastal northwestern portion and the northeastern (San Felipe Desert area) portion where it isreplaced by *C. w. wislizeni* (Figure 6).

Crotaphytus wislizeni neseotes, n. subsp.[2]

Figures 4 and 5

Type: California Academy of Sciences Number 79872. Adult male collected by Mr. Joseph Richard Slevin on Cedros Island, west coast of Baja California Norte, Mexico, between April 25, and May 30, 1940.

Paratypes: (N = 37) MEXICO: Baja California, Cedros Island; no specific area of island cited (MCZ 45722-3, CAS 8843-4, 56182. 56184-6, 59587, 79866-74, AMNH 5544, SDNHM 7249, 15969, 17411, 24340-2, CNHM 130291-8), Canyon of Middle Canyon (SDNHM 27693-5), S end (SDNHM 5264).

1. Number (mean) Range.
2. The term *neseotes* refers to the fact that this is an insular race.

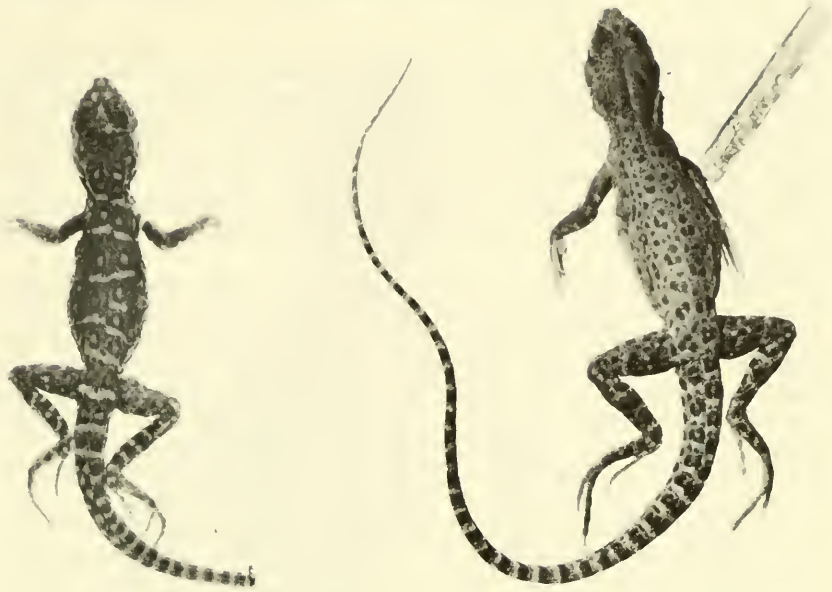

Figure 3. Dorsal view of juvenile from Cadeje, Baja California, showing dorsal pattern on single blotches which later diverge into subunits of 2-4. Photograph by Charles A. Torbit, Jr.

Figure 4. Dorsal view of holotype [CAS 79872] of *Crotaphytus wislizeni neseotes*. Photograph by Maurice Giles.

Diagnosis: An insular population of *Crotaphytus wislizeni* closely related to adjacent peninsula Baja California (*C. w. copei*), but differing from the latter in, 1) number of body ventrals (Cedros Island: 37(91.2162)83-105; Baja California: 44(96.0454)86-108; 2) number of mediodorsal scales: 73(190.7837)169-202; 3) fewer ventrals into head: 37(58.0270)44-68; 4) longer snout-vent length 37(96.6216)87-124; 5) shorter tail length 35(214.7428)106-270; 6) longer head: 37(25.054)16-33; 7) wider head: 37(19.2702)11-24; 8) longer snout: 37(11.7027)7-15; 9) slightly greater number of femoral pores: 37(45.9729)37-59. For a comparison of these statistics compared with the Baja California population, see Tables 1, 2.

Description of Type: An adult male, snout-vent length 93, tail length 228, total length 321, ratio of tail/total length .71. Eye orbit to rostral distance 11.2; eye orbit to ear distance 7.5; rostral to ear distance 23. Head distinct, head width 18; head depth 13.4. Appendages well developed, right foreleg length 37.5; right hindleg length 82; longest toe 33.5. Number of dorsal scales (occiput to base of tail) 196; dorsomedial head scales (occiput to and including rostral) 24; ventromedial body scales 97; ventromedial head scales 70 (including mental), nuchals approximately 6 and gray in color, supralabials 22/22; infralabials 23/21. Femoral pores 25/27, small scales contacting pores posteriorly. Internasals 6; postmentals 2-2;

interorbitals 4; postrostrals 4-4; scales between rostral and nasals 2-2. Dorsal tail bands 46. Dorsum light olive brown; round darker olive brown blotches conspicuous; large spot pattern conspicuously broken into smaller oval spots consisting of two to four components, each separated by small white spots. Gulars less than 50 percent dark gray, gray gular stripes 7 in number and wide (3-5 scales) with interconnecting transverse fusions especially noticeable anteriorly and posteriorly. Venter cream with gray scales anteriorly and laterally.

Sexual Dimorphism: A most unique characteristic of the Cedros Island population is the extent of its sexual dimorphism. Cedros Island females are larger than the males, femoral pore counts are slightly greater than the males, dorsal body scales are significantly greater in females, tail lengths of females are greater than males, head lengths of females are also greater than males, head width and snout length are likewise greater in females. See Tables 1 and 2.

Range: Restricted to Cedros Island, Eastern Pacific Ocean, off the west coast of central Baja California, Mexico (Figure 6).

Remarks: The Cedros Island population of *Crotaphytus wislizeni* is readily distinguished from mainland peninsula populations primarily by the larger size attained by the individuals composing it. In contrast to the dwarfing of the Cedros Island rattlesnake, *Crotalus exsul* Garman (cf. Klauber 1931, 1949), the leopard lizards have developed in the opposite direction, toward larger size. This phenomenon of relative giantism is also characteristic of several other reptiles inhabiting islands surrounding Baja California (e.g., *Uta palmeri* from Isla San Pedro Martir, *Crotalus mitchelli angelensis* Klauber (1963) from Isla Angel de la Guarda and *Sauromalus varius* from San Esteban Island in the Gulf of California).

Most of the reptiles found on Cedros Island are relatively distinct from their closest counterparts on the adjacent Baja California peninsula and have received nomenclatural status (cf. Yarrow, 1882; Garman, 1883; Stejneger, 1889, 1893; Fitch, 1934; Klauber, 1946; Zweifel, 1958). One of the two specimens of the colubrid genus *Chilomeniscus* was very distinct from peninsula samples available and has been reported upon by Banta and Leviton (1963). According to Durham and Allison (1960) Cedros Island has been separated from the Vizcaino Peninsula of Baja California since the Miocene. This is seemingly enough time to have allowed for the degree of differentiation exhibited by the reptile fauna, if indeed the animals have been extant on the island for that period of time.

One of the specimens (LMK 24340) is a gravid female containing two eggs with lengths ranging from 22 to 24 mm. and widths of 15 to 16 mm. However, the main interest of this specimen is in the length of the tail (snout-vent 106, tail length 38) most of which was obviously removed in some way or other, but rather than being regenerated as is the case with most iguanid and many other lizard groups, only a very healed-over stub remains. Also in the stomach of another adult female (CAS 8843), a grasshopper and an adult lizard (*Uta concinna*) was found.

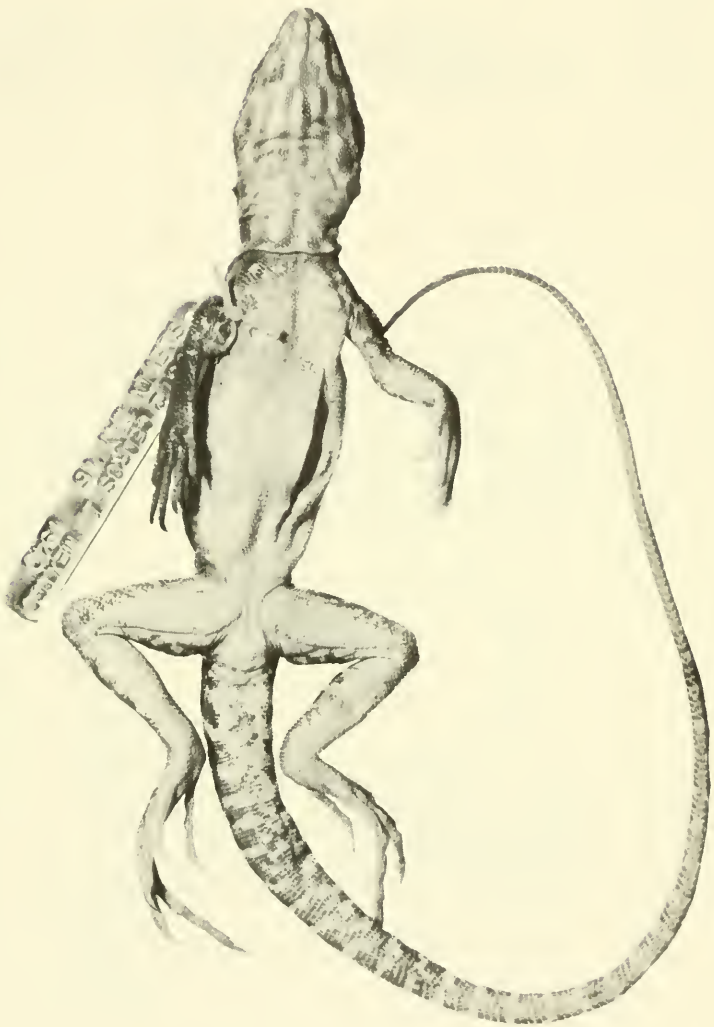

Figure 5. Ventral views of holotype of *Crotaphytus wislizeni nexeotes*. Photograph by Maurice Giles.

We have not seen the coloration of living gravid females of the Cedros Island population. The extent of the usually brilliant orange or vermillion color in the females of mainland leopard lizard populations suggests that this character might be useful in population segregation. However, the description of this character in the Cedros Island population and the pattern in juveniles will have to wait until suitable color and pattern data become available.

TABLE 1. COMPARISONS OF MEANS OF SELECTED MERISTIC CHARACTERS BETWEEN SAMPLES OF *CROTAPHYTUS WISLIZENI* FROM CEDROS ISLAND (A) AND FROM BAJA CALIFORNIA (B)

Character		♂♂	♀♀	♂/♀ Mean Ratio
	A	(N=16)	(N-21)	
	B	(N=23)	(N-21)	
Femoral pores (total of right and left thighs)	A	(43-50)44.88	(37.59)46.81	.958
	B	(38-53)46.09	(40.53)45.38	1.015
Postmentals	A	(3-5)3.75	(2.5)3.57	1.05
	B	(2.6)4.04	(3.5)3.81	1.06
Dorsal body scales	A	(180-201)187	(169-202)193.66	.9656
	B	(175-227)200.73[1]	(183-212)197.29	1.01743
Ventral body scales	A	(83-100)91	(83-105)91.42	.99540
	B	(86-110)95.63	(89-108)96.29	.99522
Dorsomedial head scales	A	(22-26)23.63	(20-28)23.24	1.01678
	B	(21-27)23.14[2]	(20-25)22.81[1]	1.01446
Ventrals into head	A	(44.68)57-19	(55-69)58	.98603
	B	(55-73)63.5	(56-72)63.2[2]	1.00474
Internasals	A	(5-7)6.44	(5-7)6.29	1.02384
	B	(6-8)6.65[3]	(5-8)6.47[4]	1.02782

1. N = 22
2. N = 21
3. N = 20
4. N = 19

Overall ♂/♀ Mean Ratios: A .99937; B 1.01923

♂/♀ Mean Ratio Range: A .958 - 1.02384; B .99522 - 1.02782

TABLE 2. COMPARISONS OF MORPHOMETRIC DATA BETWEEN SAMPLES FROM CEDROS ISLAND (A) AND FROM PENINSULA BAJA CALIFORNIA (B)

Character		Males	Females	♂/♀ Mean Ratios
Snout-Vent Length	A	16(52-115)89.375	21(52-120)102.1428	.8750
	B	24(52-112)91.333	22(58-121)97.8636	.93326
Tail Length	A	16(106-232)198.375	19(129-267)228.5263	.8680
	B	20(104-258)212.2	21(135-253)224.7619	.9441
Head Length	A	16(15-27)23	21(16-33)26.619	.864
	B	24(13-28)23.4166	22(15-28)24.9545	.93837
Head Width	A	16(11-22)17.875	21(13-24)20.33	.87924
	B	24(10-22)17.4166	22(15-23)18.18	.958
Snout Length	A	16(7-13)10.9375	21(7-12)12.2857	.89026
	B	24(6-14)10.625	22(6-14)11	.9659
Length of Hindleg	A	17(45-90)74.1764	21(49-97)81.5714	.90934
	B	24(40-89)76.166	23(46-102)80.3913	.94744
Length of Foreleg	A	17(22-44)34.4117	21(31-47)39.8095	.8644
	B	24(21-45)36.4166	24(24-48)38.5416	.94486

Overall ♂/♀ Mean Ratios: A .8786; B .94741

♂/♀ Mean Ratio Range: A .864 - .90934; B .93837 - .9659

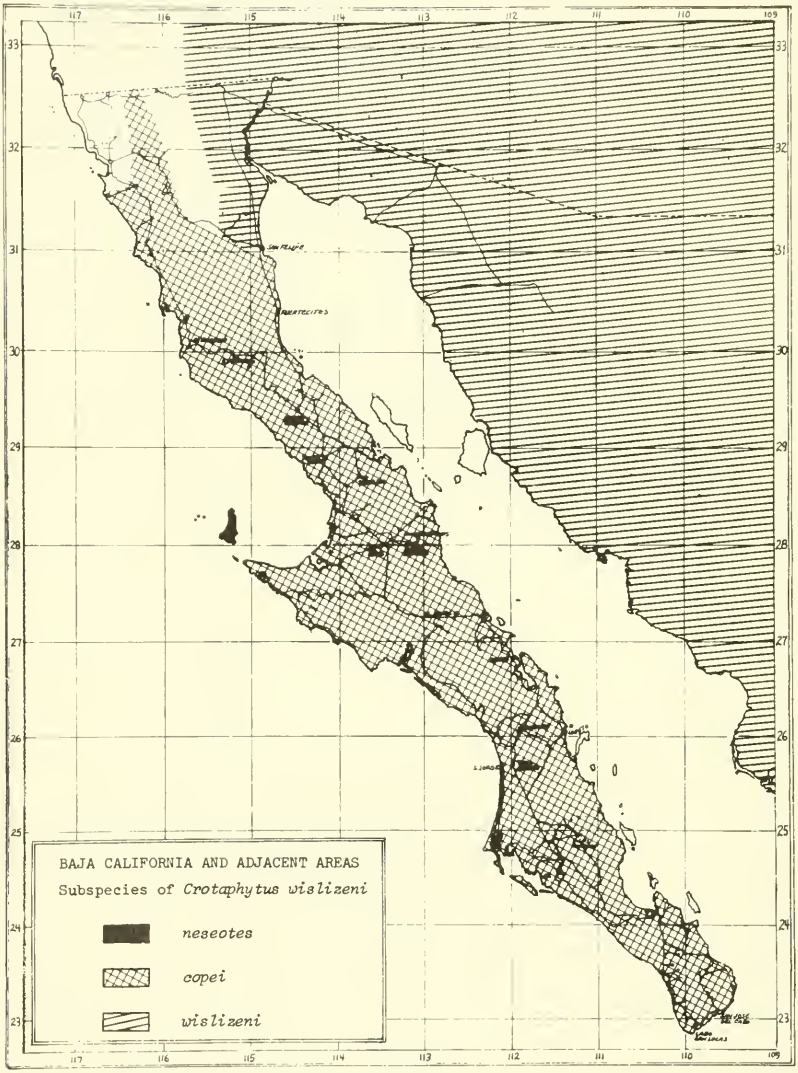

Figure 6. Map indicating occurrences of samples of *Crotaphytus wislizeni copei*, *C. w. neseotes*, and *C. w. wislizeni* in the Baja California region.

Crotaphytus wislizeni wislizeni Baird and Girard, 1852

Material Examined: (N=2) Baja California Norte: 2 mi S San Felipe (UCLA 10735)*; 6 mi SE mouth of Tajo Canyon, Laguna Salada (UCLA 5544).*

*Now deposited in the herpetological collections of the Los Angeles County Museum of Natural History

RANGE: Northeastern section of Baja California Norte, Mexico (Figure 6).

REMARKS: The San Felipe Desert area of northeastern Baja California is inhabited by populations readily designated as *C. w. wislizeni* with the characteristic dorsal spots encircled by small white dots. The extent of the intergradation with *C. w. copei* remains to be determined when more adequate samples become available.

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NEW SPECIES OF PERENNIAL CRYPTANTHA FROM UTAH

Larry C. Higgins[1]

In the spring of 1968 while preparing a dissertation on the perennial *Cryptantha*, section *Oreocarya* (Greene) Payson of North America the present writer discovered three new taxa of *Cryptantha* from Utah.

1. *Cryptantha johnstonii* Higgins sp. nov.

Herba perennis caespitosa. 1-2.5 dm alta; caules pluri e radice profunda lignosa erumpentes, 0.6-1.3 dm longi, minute strigosi; folia oblanceolata, obtusa vel acuta, 2-6.5 cm longa, 0.4-1 cm lata, subtus strigosa et pustulata, supra uniformiter strigosa et non pustulata; inflorescentia elongata, laxa, 0.5-2 dm longa; bracteae inconspicuae, 1-2 cm longae; sepala lineari-lanceolata, sub anthesi 5-6 mm longa, sub fructibus 8-10 mm longa, strigosa et albo-setosa; pedicelli 0.5-1 mm longi; corolla alba, tuba 12-15 mm longa, cristae basi tubae nullae, fornices flavi, erecti, emarginati, 1-1.5 mm longi, limbus patenter, 13-17 mm latus; stylus excedens fructum 3-8 mm (heterostylus); nuculae 4, ovatae, 3-3.5 mm longae, 2.3-2.7 mm latae, margine acuto, utrinquae laevibus et lucidis, sulco angustissimo-lineari, margine elevato nullo.

Caespitose perennial 1-2.5 dm tall; stems several, arising from the branched caudex, 0.6-1.3 dm long, very weakly strigose; leaves oblanceolate, the apices obtuse to acute, 2-6.5 cm long, 0.4-1 cm wide, dorsal surface strigose with conspicuous pustulate hairs; inflorescence somewhat open, 0.5-2 dm long; foliar bracts evident but not conspicuous, 1-2 cm long; calyx segments linear-lanceolate in anthesis 5-6 mm long, in fruit 8-10 mm long, strigose and spreading white setose; pedicels 0.5-1 mm long; corolla white, the tube 12-15 mm long, flaring in the throat, crests at base of tube lacking, fornices yellow, emarginate, 1-1.5 mm long, papillose, limb 13-17 mm broad; style exceeding mature fruit 3-8 mm (heterostyled); nutlets ovate, usually all 4 maturing, the margins acute or knife-like, in contact, 3-3.5 mm long, 2.3-2.7 mm wide, both surfaces smooth and glossy, scar straight closed, extending from base ⅔ the length of nutlet, elevated margin lacking.

Type. Utah: Emery County, on low rolling hills ca. 15 miles west of hwy. 50-6 along the road from Woodside to Castle Dale, May 25, 1968, *Larry C. Higgins 1310*. Holotype deposited at BRY. Isotypes will be distributed to CAS, GH, NY, POM, RM, US, UTC, and other major herbaria.

Distribution. Known only from the type locality 15 miles west

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of hwy. 50-6 on the San Rafael Swell, Emery County, Utah. Flowering from May to June.

Specimens Examined. Utah: Emery County, San Rafael, *Harrison 5628* BRY.

This distinctive species was first called to my attention by an immature specimen deposited in the herbarium at Brigham Young University. Later in the spring of 1968 several trips were made to the San Rafael Swell in order to relocate this species.

Cryptantha johnstonii is most closely related to *C. confertiflora* (Greene) Payson known from western Utah, northern Arizona, Nevada, and southwestern California. It can be distinguished from that species by its smaller size, longer and more open inflorescence, white flower color, larger corolla with longer fornices and no basal crest.

The plant is named in honor of the late Dr. Ivan M. Johnston, Harvard University, who was one of the foremost workers in Boraginaceae. It is only rightful that one of the most showy species in the entire genus should bear his name.

2. *Cryptantha compacta* Higgins sp. nov.

Herba perennis dense caespitosa, 0.3-1 dm alta; caules numerosi e radice profunda lignosa erumpentes, 0.1-0.4 dm longi, subtus albotomentosi, supra subtiliter strigosi: folia oblanceolata vel spatulata, obtusa, 0.5-1.5 (2) cm longa, 0.2-0.4 cm lata, adpressa setosi-pustulata et dense strigosa vel subtomentosa; inflorescentia angusta, aliquantum capitata, 1-5 cm longa; bracteae inconspicuae; sepala lanceolata, sub anthesi 2-2.5 mm longa, sub fructibus 3.5-4.5 (5) mm longa, dense albo-setosa et subtomentosa; corolla alba, tuba 1.8-2.2 mm longa, cristae basi tuba evidentes, fornices flavi, rotundati, ca. 0.5 mm longi, papillosi, limbus 4.5-5.5 (6) mm latus; stylus aequans vel breviter quam fructum; nuculae 1-2, lancolata-ovatae, 2.5-3 mm longae, 1.5-1.8 mm latae, margine acuto, dorso convexo, muricato vel infirme tuberculato-ruguloso, pagina ventrali muricata, sulco aperto subulato vel anguste-triangulari, margine elevato destituto.

Densely caespitose perennial, 0.3-1 dm tall; stems numerous, arising from a woody root, 0.1-0.4 dm long, tomentose below, weakly strigose above; leaves oblanceolate to spatulate, obtuse, 0.5-1.5 (2) cm long, 0.2-0.4 cm wide, dorsal surface with appressed setose-pustulate bristles, also densely strigose or subtomentose, ventral surface similar but with fewer pustulate hairs, the petiole tomentose; inflorescence narrow, somewhat capitate, 1-5 cm long; foliar bracts evident but not conspicuous; calyx segments lanceolate, 2-2.5 mm long in anthesis, in fruit becoming 3.5-4.5 (5) cm long, densely white setose and subtomentose; corolla white, the tube 1.8-2.2 mm long, crests at base of tube evident, fornices yellow, rounded, papillose, about 0.5 mm long, limb 4.5-5.5 (6) mm wide; style equalling or shorter than mature fruit; nutlets lanceolate-ovate, acute, 2.5-3 mm long, 1.5-1.8 mm wide, only 1-2 maturing, dorsal surface muricate or weakly tuberculate-ruguose, ventral surface muricate, scar

open, subulate to narrowly triangular, extending ⅔ the length of the nutlet, elevated margin lacking.

Type. Utah: Millard County, ca. 8 miles west of Desert Range Experiment Station Headquarters along hwy. 21, 100 m west of pass at the north end of Needle Range, June 18, 1968, *Larry C. Higgins 1613*. Holotype deposited at BRY. Isotypes will be distributed to CAS, GH, NY, POM, US, UTC, and other major herbaria.

Distribution. Known only from southwestern Millard County, Utah, but to be expected from northern Beaver County, Utah, and perhaps in eastern Nevada. Flowering from May to July.

Specimens Examined. Utah: Millard County, north slope of Bull Grass Knoll, north end of Pine Valley, 9 miles north of Derest Range Experiment Station Headquarters, 6,500 feet, *R. C. Holmgren 521* (BRY); White Sage Valley, *Harrison 6371* (BRY); ca. 8 miles west of Desert Range Experiment Station Headquarters along hwy. 21, 100 m west of pass, *Higgins 1462* (BRY).

Cryptantha compacta is most closely related to *C. nana* (Eastw.) Payson but differs in its more compact and caespitose habit, smaller leaves, shorter calyx segments, and smaller corolla. This plant has been known for over thirty years, but has been placed with *C. nana* probably due to the immaturity of the specimens. In observing this species in the field it becomes even more apparent of its right to specific distinction due to its dense caespitose habit that more closely resembles *C. caespitosa* (A. Nels.) Payson than *C. nana*. At the type locality it is the most common plant, growing on shallow stony loam with *Sphaeralcea caespitosa* M. E. Jones, *Linum perenne* L. ssp. *lewisii* (Pursh) Hult., and *Cryptantha rugulosa* (Payson) Payson.

3. *Cryptantha ochroleuca* Higgins sp. nov.

Herba perennis humilis caespitosa, 0.2-1.3 dm alta; caules pluri, 0.1-0.4 dm longi, strigosi et setulosi; folia lineari-lanceolata vel oblanceolata, acuta vel obtusa, 1-2.5 cm longa, 0.1-0.3 cm lata, folia basiorum uniformiter et dense strigosorum, folia caulinum strigosorum et setosorum, pustulatorum; inflorescentia angusta, 0.2-0.7 dm longa, setulosa; sepala lineari-lanceolata, sub anthesi 2-2.5 (3) mm longa, sub fructibus 4-6 mm longa, setosa; corolla lutescens, tuba 2-2.5 mm longa, cristae basi tubae conspicuae, fornices flavi, rotundati, ca. 0.3 mm longi, limbus 4-5 mm latus; stylus vix excedens fructum; nuculae lanceolatae, 2.5-3 mm longae, 1.4-1.6 mm latae, vulgo non nisi unae maturescentes, margine acuto, dorso convexo, irregulariter curto ruguloso, pagina ventrali non nisi leviter aspera, sulco aperto anguste-triangulari, margine elevato destituto.

Low caespitose perennial, 0.2-1.3 dm tall; stems several, 0.1-0.4 dm long, strigose and weakly setose; leaves linear-oblanceolate to oblanceolate, the apices acute or sometimes obtuse, 1-2.5 cm long, 0.1-0.3 cm wide, basal leaves uniformly and densely strigose, sparsely setose, the petiole white-hairy, cauline leaves strigose and with some setose-pustulate bristles; inflorescence narrow, 0.2-0.7 dm long,

weakly setose; calyx segments linear-lanceolate, 2-2.5 (3) mm long in anthesis, in fruit 4-6 mm long, setose; corolla pale-yellow, the tube 2-2.5 mm long, crests at base of tube conspicuous, fornices yellow, rounded, about 0.3 mm long, limb 4-5 mm wide; style scarcely surpassing mature fruit; nutlets lanceolate, 2.5-3 mm long, 1.4-1.6 mm wide, usually only one maturing, margine acute, dorsal surface irregularly rugose with low rounded ridges, ventral surface only slightly uneven, scar open, narrowly-triangular, extending ¾ the length of nutlet, no elevated margin.

Type. Utah: Garfield County, on outcrop 100 m south of Red Canyon Campground along hwy. 12, 6,500 feet, July 21, 1968, *Larry C. Higgins 1788*. Holotype deposited at BRY. Isotypes will be distributed to GH, NY, US.

Distribution. Limited to the red Wasatch Formation near Red Canyon Campground in southwestern Garfield County, Utah, 6,500 to 7,000 feet. Flowering from May to August.

Specimens Examined. Utah: Garfield County, top of ridge south of Red Canyon Campground in Red Canyon, May 25, 1968, *Reveal & Reveal 1031* (BRY).

This local species is apparently confined to the red Wasatch Formation in southwestern Garfield County, Utah.

Cryptantha ochroleuca is apparently most closely related to *C. caespitosa* of southwestern Wyoming, but also has some affinities with *C. nana*. The new species differs from *C. caespitosa* by its less caespitose habit, the slender, less woody taproot, shorter calyx segments, shorter, pale yellow instead of white corolla, and smaller nutlets which are more rugose. From *C. nana*, *C. ochroleuca* differs by the shorter calyx segments, pale yellow corolla, and the rugose nutlets.

NOTES

A PROBABLE RECORD OF THE WHITE-TAILED DEER IN NEVADA

A shed left antler, slightly weathered, was found by Charles G. Hansen between Rug Mountain and Dead Horse Trail, 46 miles north of Las Vegas, Nevada on the Desert National Wildlife Range. The antler (M5558), on deposit in the Biology Museum at Nevada Southern University, was found in a steep-sided dry wash on the alluvial fan between the main Sheep Range and Tule Deer Ridge at an elevation of approximately 5,000 ft. The surrounding vegetation is dominated by joshua tree (*Yucca brevifolia*), pinyon pine (*Pinus monophylla*), and juniper (*Juniperus osteosperma*).

On the basis of the weathered and bleached condition we estimate that it was shed within the last 5 to 10 years. The antler is 267 mm. in length and the two tines are 82 and 61 mm. in length. Both tines arise from the single main beam and from the slope of the base the antler curved out over the brow. These features are characteristic of the white-tailed deer (*Odocoileus virginianus*). However, Kellogg (1956) stated that there may be exception to the normal dichotomous forking of the antlers of mule deer (*Odocoileus hemionus*) and discussed a specimen from the Kaibab plateau, Arizona with antlers which were branched as in the white-tailed deer. The shed antler was compared with over 300 mule deer skulls from Nevada on deposit at the Nevada Southern University Biology Museum. All of these which had tines exhibited the normal dichotomous branching. Mule deer with antlers of a comparable length were usually not forked or, if forked, had dichotomous tines of longer length than that of the shed antler. The shed antler was not as rounded in cross section and had fewer burrs near the base than the mule deer antlers examined.

Based on this examination we conclude that the shed antler probably belonged to a white-tailed deer. Hall (1946) discussed the status of this species in Northern Nevada and concluded that there were no authentic records for the state. The nearest record of white-tailed deer is Bill Williams Mountain, Coconino County, Arizona, which is approximately 190 airline miles southeast of the Nevada locality (Hoffmeister, 1962). The present record tentatively places this species in Southern Nevada.—W. Glen Bradley[1] and Charles G. Hansen[2].

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HIGH LOCALIZED BIRD MORTALITY AS A FUNCTION OF HIGH INSECT POPULATIONS

During the weeks of at least 28 April and 5 May 1968, extremely large numbers of Painted Lady Butterflies (*Vanessa carduie*) Linnaeus, were migrating north through the Salt Lake valley region. These butterflies were so numerous that estimations as to total population numbers would be a "gloriously wild guess" but the population was certainly in the several thousands at any one time in the valley proper. This migration was recorded at numerous localities throughout the state (Wm. H. Behle, pers. comm.). On 30 April, one of us had occasion to travel highway Interstate 80 south to Provo and north to Ogden, Utah. Again on 7 May, I.80 was traveled to Provo. Maimed and also freshly killed butterflies, both intact and mashed, littered the highways. Birds were repeatedly seen to dart in between passing cars, grab a butterfly and return to the shoulder of the road to eat the insect. Many birds would also merely hop around on the highway proper and pick up and eat the butterflies. Because of the high speeds at which the automobiles traveled, many birds were not fast enough to evade the cars and were killed. Many were mashed on the highways and others were laying on the shoulders of the roads. The following list indicates the numbers of dead birds counted on the 21 registered mile stretch of road to Provo and 15 registered mile stretch to Ogden on which butterflies occurred on 30 April and the 17 plus miles on which butterflies occurred on 7 May.

Salt Lake-Provo, 30 April, Brewer's Blackbird (*Euphagus cyanocephalus*), 27; Red-winged Blackbird (*Agelaius phoeniceus*), 12; House Sparrow (*Passer domenticus*), 9; Starling (*Sturnus vulgarus*), 9; unidentified species, 8; Sparrow Hawk (*Falco sparverius*), 1. This mortality averages 3.14 dead birds per measured mile. Salt Lake-Ogden, 30 April, Brewer's Blackbird, 19; House Sparrow, 19; Meadowlark (*Sternella neglecta*), 3; Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*), 3; Starling, 3; unidentified, 3. This mortality averages 3.20 dead birds per measured mile. Salt Lake-Provo, 7 May, Brewer's Blackbird, 8; Starling, 7; House Sparrow, 7; Red-winged Blackbird, 2; Meadowlark, 1; Western Tanager (*Piranga ludoviciana*), 1; Bullock's Oriole (*Icterus bullockii*), 1; Unidentified passerines, 7; Sparrow Hawk, 1 (may have been bird previously noted). This mortality averages 2.05 dead birds per measured mile. It would be impossible to guess how many birds went unnoticed and it is believed that none, except perhaps the Sparrow Hawk, was counted twice. If similar mortality occurred, in areas of reproducable conditions, throughout the total period and distance of the *Vanessa* migration, then bird mortality could conceivably be considerable. Likewise, after enough actual counts were made, it would be possible to calculate hypothetical bird mortality rates provided the route and extent of the *Vanessa* migration were determined.—Hal L. Black, Department of Zoology, University of New Mexico, Albuquerque, New Mexico, and Clayton M. White, Department of Zoology, University of Utah, Salt Lake City, Utah. (Present address, Section of Ecology and Systematics, Langmuir Laboratory, Cornell University, Ithaca, New York.)

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